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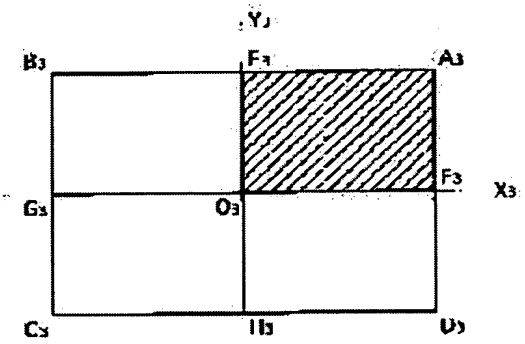
(54) IMAGE PROCESSOR

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce image correction processing time or an image correction data amount and to efficiently execute image correction by considering the symmetry of the deterioration degree of images, related to the center point or center line of an image areas and correcting the entire image from the correction amount of a part of the image at correction of the image.

SOLUTION: Shading is provided with a feature of almost line symmetry around a center line X3 and a center line Y3 of an image area and almost point symmetry about the center point O3. Thus, by using the symmetry, a correction operation is performed for respective pixels for the 1/4 area A3E3O3F3 of the area A3B3C3D3 of the entire image, and a correction amount is obtained. Also, correction data composed of the correction amount of the area A3E3O3F3 are prepared in advance are and held in a storage part, the correction data are called as needed and the correction amount is obtained. Then, by conducting image correction of the other area, the area E3B3G3O3 to be line symmetrical to the center line Y3 with the area A3E3O3F3 for instance, by using the correction amount, the image correction of the entire image is performed.



* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]It is an image processing device which amends to image data of a picture formed optically, An image processing device, wherein it has a compensation means which performs picture amendment which amends degradation of image quality to image data and this compensation means amends the whole picture from some correction amounts of said picture using the object nature of degradation of image quality about the central point or a center line of an imaging range.
[Claim 2]The image processing device according to claim 1 which amends degradation of image quality resulting from an optical system of image reading at the time of said compensation means obtaining degradation or said image data of image quality resulting from a taking lens which photoed said picture.
[Claim 3]Picture amendment which amends degradation of image quality resulting from said taking lens, amendment of a distortion aberration resulting from said taking lens, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, and a picture focus -- it being at least one of amendments of a Japanese quince, and, Picture amendment which amends degradation of image quality resulting from an optical system of said image reading, Amendment of shading resulting from an optical system, amendment of a distortion aberration resulting from an image formation lens of said optical system, a picture focus resulting from amendment of the chromatic aberration of magnification resulting from said image formation lens, amendment of the amount fall of ambient light resulting from said image formation lens, and said image formation lens -- the image processing device according to claim 2 which is at least one of amendments of a Japanese quince.
[Claim 4]The image processing device according to any one of claims 1 to 3 which said compensation means calculates and calculates some correction amounts of said picture from a correction function, and amends the whole picture using this correction amount.
[Claim 5]The image processing device according to any one of claims 1 to 3 which said compensation means holds amendment data which calculated some correction amounts of a picture beforehand in consideration of object nature to a center position or a center line of a picture of said correction function, and amends the whole picture using this amendment data.
[Claim 6]The image processing devices according to claim 5 fewer than a storage capacity which needs capacity of a storage parts store for holding said amendment data in order to hold amendment data of the whole picture.
[Claim 7]Said shading compensation a correction amount of light volume nonuniformity which becomes settled from a diaphragm value or zoom magnifying power of an optical system lens to which image formation of the picture photoed by film in order to read image data in photoelectricity is carried out, The image processing device according to any one of claims 3 to 6 which amends by using with read sensitivity for every pixel at the time of reading in photoelectricity.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention is an image processing device which amends degradation of the image quality of the picture resulting from the optical system containing the taking lens which photoed the picture, and the image formation lens of an image reader, and belongs to the technical field of the image processing device which can reduce picture correction processing time and the amount of picture correction data, and can perform picture amendment efficiently.
[0002]
[Description of the Prior Art]Now, baking to the photosensitive materials (photographic paper) of the picture photoed by photographic films (it is hereafter considered as a film), such as a negative film and a reversal film, is directly performed by what is called exposure (analog exposure) that projects the picture of a film on photosensitive materials and carries out field exposure of the photosensitive materials.
[0003]on the other hand, the printing equipment which uses digital exposure in recent years -- that is, After reading in photoelectricity the picture recorded on the film and making the read picture into a digital signal, Various image processing was performed and it was considered as the image data for record, and scanning exposure of the photosensitive materials was carried out by the recording light modulated according to this image data, the picture (latent image) was recorded, and the digital photo printer considered as a print (result) was put in practical use.
[0004]In a digital photo printer, since image data processing can determine the exposing condition at the time of printing as digital image data, a picture, The jump of a picture, amendment of TSUBURE, sharpness (sharp-izing) processing resulting from a backlight, speed light photography, etc., Amendment of color FERIA or concentration Ferrier, amendment of under exposure or exaggerated exposure, amendment of the amount fall of ambient light, etc. can be performed suitably, and the high-definition print which was not directly obtained by the conventional exposure can be obtained. And an output is possible also for composition and image division of a multiple image, and the print which could perform composition of the character, etc. by image data processing further, and was freely edited / processed according to the use. And according to the digital photo printer, a print can also be created from the picture (image data) photoed with the digital camera etc., Since it can supply image data to a computer etc. or it it not only outputs a picture as a print (photograph), but can be saved at recording media, such as a floppy (registered trademark) disk, image data can be used for various uses other than a photograph.
[0005]The scanner with which such a digital photo printer reads fundamentally the picture recorded on the film in photoelectricity (image reader), It comprises an image processing device which carries out image processing of the read picture, and is made into the image data for record, and a printer (image recorder) which carries out scanning exposure of the photosensitive materials according to this image data, performs a development, and is considered as a print.
[0006]In a scanner, enter into a film the read light ejected from the light source, and the projected light which supports the picture photoed by the film is obtained, After reading a picture and performing various kinds of image processing if needed by carrying out image formation of

this projected light to image sensors, such as a CCD sensor, and carrying out photoelectric conversion with an optical system image formation lens, it sends to an image processing device as image data (image data signal) of a film. An image processing device sets up an image processing condition from the image data read with the scanner, performs image processing according to the set-up conditions to image data, and sends it to a printer as output image data (exposing condition) for image recording. In a printer, if it is a device using optical beam scanning exposure, according to the image data sent from the image processing device, modulate an optical beam, carry out scanning exposure (printed) of the photosensitive materials in two dimensions, form a latent image, and it ranks second, for example, A predetermined development etc. are performed and it is considered as the print (photograph) in which the picture photoed by the film was reproduced.

[0007]By the way, the chromatic aberration of magnification which originates in the taking lens of the camera which photoed the picture as a cause of degradation of the image quality of the picture reproduced by the print, a distortion aberration, the amount fall of ambient light, and a picture focus -- the chromatic aberration of magnification resulting from the image formation lens [Japanese quince] of the image reader read in photoelectricity, a distortion aberration, the amount fall of ambient light, and a picture focus -- shading resulting from the optical system containing the image formation lens of a Japanese quince or an image reader is mentioned.

[0008]Although a color picture is formed of the three primary colors of red (R) green (G) and blue (B), since the refractive index (image formation magnification) of a lens changes delicately with wavelength, a color gap will produce it in the picture acquired by the image formation magnification of the light of R, G, and B differing, namely, the chromatic aberration of magnification arising. In order to obtain a proper taken image, image formation of the flat surface vertical to the optic axis in a scene needs to be carried out on the same vertical flat surface to an optic axis. However, in the usual lens, the picture from which an image formation face shifts to an optical axis direction and which was acquired by producing what is called a distortion aberration and distorting an image formation picture (producing distortion) will become what has distortion. the fall of the amount of ambient light to which a picture becomes dark rather than the central part in the periphery produced according to the performance of a taking lens or an image formation lens and the picture focus resulting from focus positions differing in the plane direction of a film -- the Japanese quince etc. cause degradation of image quality. The nonuniformity of light intensity arises in the performance of the light volume unevenness of the light source of an optical system, or an image formation lens, and the read light itself which were further ejected from the light source by the performance of the whole optical system, nonuniformity is made also to the light volume irradiated by the picture, and shading which produces density unevenness as a result also causes degradation of image quality.

[0009]Like a single lens reflex camera, if it is a camera which can hang a certain amount of cost, the image quality deterioration of the picture resulting from a taking lens can be controlled by combining two or more more lenses using a high-precision taking lens. If an image reader can hang cost to some extent, degradation of the picture resulting from the optical system containing an image formation lens can be controlled by using an optical system precise again by combining two or more more lenses using a high-precision image formation lens. However, in a disposable camera or a cheap compact camera. since cost cannot be hung on a lens and cost cannot be hung so much on an image formation lens, an optical system, etc. in a simple and small image reader -- a picture -- the fall of the chromatic aberration of magnification, a distortion aberration, and the amount of ambient light, and a picture focus -- a Japanese quince and shading will arise. As a result, the problem used as the picture in which image quality deteriorated produces the picture reproduced as a print.

[0010]To such a problem, the information about a taking lens, etc. were acquired and the photographic processing device which judges degradation of image quality based on acquisition information, and amends degradation of the image quality of a picture based on the judged degradation state is proposed so that it may be mentioned to JP,9-281613,A. In the above-mentioned photographic processing device, the degradation state of the image quality of a picture is judged based on the information about the acquired taking lens, etc., a fall and picture

focus of the chromatic aberration of magnification of the picture which amends the whole picture in quest of the correction amount of the whole picture according to judgment, and originates in a taking lens, a distortion aberration, and the amount of ambient light -- a Japanese quince can be amended.

[0011]

[Problem(s) to be Solved by the Invention]by the way, a fall and picture focus of the chromatic aberration of magnification of the picture which originates in a taking lens in the above-mentioned photographic processing device, a distortion aberration, and the amount of ambient light -- since the whole picture is amended by calculating a correction amount over the whole picture when amending a Japanese quince, it is necessary to calculate a correction amount for every pixel Depending on the size of a picture, a correction amount must be calculated for every pixel also, for example from big image data like image data (2000 pixels x 1000 pixels). Therefore, the problem that the processing time which calculates and calculates a correction amount for every pixel will increase arose. Although carrying out the hold stores of the amendment data which calculated beforehand the correction amount for amending to image data for every pixel for every pixel of a picture is also considered, According to big image data, it became large, the reading time of amendment data also started, and efficient picture amendment could not be performed, but the problem that a simple and small image reader was unrealizable also produced the storage capacity required for amendment data.

[0012]In the above-mentioned photographic processing device, the degradation state of the image quality of a picture is judged based on the information about a taking lens, etc., the picture is only amended according to judgment, and degradation of the image quality resulting from the image formation lens or optical system of a simple image reader cannot be controlled.

[0013]Then, in the image processing device which performs picture amendment for the image data of the picture photoed optically as image data for an input, and obtains the image data for an output in order that this invention may solve the above-mentioned problem, When performing picture amendment which corrects degradation of the image quality of the picture resulting from the optical system containing the taking lens which photoed the picture, and the image formation lens of an image reader, reduce picture correction processing time and the amount of picture correction data is reduced, It aims at providing the image processing device which can perform picture amendment efficiently.

[0014]

[Means for Solving the Problem]To achieve the above objects, this invention is an image processing device which amends to image data of a picture formed optically, It has a compensation means which performs picture amendment which amends degradation of image quality to image data, and an image processing device, wherein this compensation means amends the whole picture from some correction amounts of said picture using the object nature of degradation of image quality about the central point or a center line of an imaging range is provided.

[0015]As for said compensation means, it is preferred in that case to amend degradation of image quality resulting from an optical system of image reading at the time of obtaining degradation or said image data of image quality resulting from a taking lens which photoed said picture, Picture amendment which amends degradation of image quality resulting from said taking lens, amendment of a distortion aberration resulting from said taking lens, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, and a picture focus -- it being at least one of amendments of a Japanese quince, and, Picture amendment which amends degradation of image quality resulting from an optical system of said image reading, Amendment of shading resulting from an optical system, amendment of a distortion aberration resulting from an image formation lens of said optical system, a picture focus resulting from amendment of the chromatic aberration of magnification resulting from said image formation lens, amendment of the amount fall of ambient light resulting from said image formation lens, and said image formation lens -- it is preferred that it is at least one of amendments of a Japanese quince.

[0016]As for said compensation means, it is preferred to calculate and calculate some correction

amounts of said picture from a correction function, and to amend the whole picture using this correction amount, and said compensation means, In consideration of object nature to a center position or a center line of a picture of said correction function, amendment data which calculated some correction amounts of a picture beforehand may be held, and the whole picture may be amended using this amendment data. In that case, few things are more preferred than a storage capacity which needs capacity of a storage parts store for holding said amendment data in order to hold amendment data of the whole picture. As for said shading compensation, in order to read image data in photoelectricity, it is preferred to amend by using with read sensitivity for every pixel at the time of reading in photoelectricity a correction amount of light volume nonuniformity which becomes settled from a diaphragm value or zoom magnifying power of an optical system lens to which image formation of the picture photoed by film is carried out.

[0017]

[Embodiment of the Invention]Hereafter, the image processing device of this invention is explained in detail based on the preferred embodiment shown in an attached drawing.

[0018]The block diagram of an example of the digital photo printer 10 provided with the image processing device of this invention is shown in drawing 1. The digital photo printer (it is hereafter considered as the photograph printer 10) shown in drawing 1, The scanner (image reader) 12 which reads fundamentally the picture photoed by the film F in photoelectricity, The image processing device 14 which performs image processing of image data, operation, control of the photograph printer 10 whole which were read, It has the printer 16 which carries out image exposure of the photosensitive materials (photographic paper), carries out a development, and is outputted as a print (result), and comprises an optical beam modulated according to the image data outputted from the image processing device 14. The operating system 18 which has the keyboard 18a and the mouse 18b for inputting directions of the input (setting out) of various conditions, selection of processing and directions, a color/density correction, etc., etc., etc. into the image processing device 14, The monitor 20 which displays the picture read with the scanner 12, various kinds of operator guidance, setting out/registration picture of various conditions, etc. is connected.

[0019]The scanner 12 is a device which reads at a time in photoelectricity one top of pictures photoed by the film F etc., The colored filter board 26 which has a colored filter of three sheets of the light source 22, the variable aperture 24, R for decomposing a picture into the three primary colors of R (red), G (green), and B (blue), G, and B, rotates and acts arbitrary colored filters on an optical path, The diffusion box 28 which makes uniform read light which enters into the film F in the plane direction of the film F, The image formation lens unit 32 and CCD sensor 34 which is the area sensors which read the picture of one top of a film, It has the amplifier (amplifier) 36, and is constituted and the light source 22, the variable aperture 24, the colored filter board 26, the diffusion box 28, and the image formation lens unit 32 form the optical system 33.

[0020]In the photograph printer 10 of the example of a graphic display, The kinds and sizes of a film, such as an advanced photo system (Advanced Photo System) and a negative (or reversal) film of 135 sizes, According to the kind of processing of the gestalt of films, such as SUTORIPPUSU and a slide, trimming, etc., etc., the career for exclusive use with which the main part of the scanner 12 can be equipped freely is prepared, and it can respond to various kinds of films or processing by exchanging careers. The picture (top) which is photoed by the film and with which print creation is presented is conveyed and held by this career in a predetermined reading station. As everyone knows, a magnetic recording medium is formed in the film of an advanced photo system, and cartridge ID, a film kind, etc. are recorded on it, and various kinds of data of the kind of the camera and developing machine which were used for a photographing date and photography, etc. can be recorded at the time of photography and development, etc. The reading means of this magnetic information is arranged, on the career corresponding to the film (cartridge) of an advanced photo system, when conveying a film to a reading station, magnetic information is read, and said various kinds of information is sent to the image processing device 14.

[0021]In such a scanner 12, it is ejected from the light source 22 and light volume adjustment is

carried out by the variable aperture 24, The colored filter board 26 is passed, and color adjustment is carried out, and when the read light diffused in the diffusion box 28 enters and penetrates for one top of the film F held in the predetermined reading station with a career, the projected light which supports the picture of this top photoed by the film F is obtained. Image formation of the projected light of the film F is carried out to the acceptance surface of CCD sensor 34 by the image formation lens unit 32, it is read in photoelectricity, the output signal is amplified by CCD sensor 34 with the amplifier 36, and it is sent to the image processing device 14 by it. CCD sensor 34 is a 1380x920-pixel area CCD sensor, for example.

[0022]In the scanner 12, by inserting each colored filter of the colored filter board 26 one by one, and performing such image reading 3 times, it decomposes into the three primary colors of R, G, and B, and the picture of one top is read. Here, in the photograph printer 10, in order to determine an image processing condition etc. in advance of the image reading (this scan) for outputting a print, the prescan which reads a picture with a low resolution is performed. Therefore, a total of 6 times of image reading are performed with one top.

[0023]Although the scanner 12 decomposed projected light into the three primary colors and has read the picture with the colored filter board 26 using the area CCD sensor, As a scanner used for this invention, slit scanning which reads a picture may perform image reading using three sorts of line CCD sensors corresponding to each trichromatic reading, carrying out scanning conveyance of the film F on a career.

[0024]Although the photograph printer 10 of the example of a graphic display is using as the image data supply source of the image processing device 14 the scanner 12 which reads in photoelectricity the picture photoed by films, such as a negative and reversal, As an image data supply source which supplies image data to the image processing device 14, Imaging devices which read the picture of a reflection copy besides scanner 12, such as an image reader, a digital camera, and a digital camcorder, It is usable in some numbers in various kinds of image read means and imaging means, such as media (recording medium), such as a means of communication of LAN (Local Area Network), a computer communication network, etc., a memory card, and MO (optical magnetic recording medium), the memory measure of image data, etc. In this invention, the picture acquired from these means should just be photoed optically at least.

[0025]The output signal (image data) from the scanner 12 is outputted to the image processing device 14. The block diagram of an image processing device (it is hereafter considered as the processing unit 14) is shown in drawing 2. The processing unit 14 has the data processing part 38, the prescan (frame) memory 40, this scanning (frame) memory 42, the prescan image processing portion 44, this scan picture treating part 46, and the conditioning part 48, and is constituted. Drawing 2 mainly shows an image-processing-related part and to the processing unit 14. CPU which performs control and management of the photograph printer 10 whole which contains the processing unit 14 besides this, The memory which memorizes information required for the operation of the photograph printer 10, etc., a means to determine the diaphragm value (diaphragm value of the image formation lens unit 32) of the variable aperture 24 in the case of this scan and the storage time of CCD sensor 34, etc. are arranged, The operating system 18 and the monitor 20 are connected to each part via this CPU (CPU bus).

[0026]Each output signal of R, G, and B with which the data processing part 38 was outputted from the scanner 12 is A/D (analog to digital) conversion, Log conversion, DC offset amendment, and a portion that performs amendment, a shading compensation, etc. at the time of dark. In the photograph printer 10, when it is difficult to hang cost, for example on the diffusion box 28 or image formation lens unit 32 grade, and to make the precise optical system 33 form, it is easy to generate the nonuniformity of the light intensity of shading, i.e., irradiation light. For example, near an image center, luminous intensity is strong, and luminous intensity is weak in the circumference. The strength of such a light originates in the optical system 33 whole including the optical system 33 22 of the diffusion box 28 or not only the image formation lens unit 32 but the scanner 12, i.e., a light source, the variable aperture 24, or colored filter board 26 grade, and is generated. Therefore, in such a photograph printer 10, it is necessary to perform a shading compensation proper so that the picture by almost uniform light volume can be acquired by

adjusting the brightness of a picture from the correction amount of light volume. In order to change with the diaphragm values or zoom magnifying power of the image formation lens unit 32, shading is constituted so that the correction amount of a shading compensation may also change according to a diaphragm value or zoom magnifying power.

[0027]The correction amount of such a shading compensation is defined as a correction amount of light volume, and calculates the correction amount according to a diaphragm value or zoom magnifying power from the correction function which becomes settled according to a diaphragm value or zoom magnifying power, for example, the secondary high order polynomial [3rd], for every picture element position. As shown in drawing 3, in that case shading, In order to equip mostly with the feature of point symmetry the surroundings of center line X_3 of the imaging range shown in drawing 3, and center line Y_3 around axial symmetry and central point O_3, Using this symmetry, perform correcting operation for 1/4 of field $A_3E_3O_3F_3$ of field $A_3B_3C_3D_3$ of the whole picture for every pixel, and a correction amount is calculated, The hold stores of the amendment data which comprises the correction amount of field $A_3E_3O_3F_3$ are carried out to the storage parts store which creates beforehand and is not illustrated, Call amendment data if needed, obtain a correction amount, and this correction amount is used, Picture amendment of the whole picture can be performed by carrying out picture amendment of the field $E_3B_3G_3O_3$ which becomes other field, for example, field, $A_3E_3O_3F_3$, center line Y_3, and axial symmetry. Thus, using the symmetry of shading which should be amended, the number of times of correcting operation can be lessened, and amendment data volume can be made less than a storage capacity required in order to hold the amendment data of the whole picture, and an efficient shading compensation can be performed.

[0028]Hold stores may be beforehand carried out to a storage parts store for every pixel by using the correction amount according to a diaphragm value or zoom magnifying power as amendment data, this amendment data may be called if needed, and a correction amount may be obtained. The correction amount for a shading compensation, Since it is a correction amount about light volume, the data which carried out the hold stores of the read sensitivity for every pixel beforehand with the scanner 12 in consideration of the sensitivity unevenness of the CCD element which constitutes CCD sensor 34 at the time of reading a picture in photoelectricity is called, and image data is amended according to the sensitivity of a CCD element.

[0029]In the data processing part 38, the picture signal by a prescan and a picture signal with this scan, It is processed, and it is considered as prescan data and this scanning data, and prescan data is used as the prescan memory 40, and this scanning data is memorized by this scan memory 42, respectively (storing). Prescan data and this scanning data are the same data fundamentally, except that resolution (picture element density) differs from a signal level.

[0030]This scanning data in which the prescan data memorized by the prescan memory 40 was memorized by this scan memory 42 in the prescan image processing portion 44 is processed in this scan picture treating part 46, respectively. The prescan image processing portion 44 has the LUT-MTX operation part 44A, the image processing portion 44B, and the data conversion part 44C, and is constituted. On the other hand, this scan picture treating part 46 has the LUT-MTX operation part 46A, the image processing portion 46B, and the data conversion part 46C, and is constituted.

[0031]The LUT-MTX operation part 44A and the LUT-MTX operation part 46A, It is a portion which performs color balance adjustment, contrast correction (gradation processing), luminosity amendment, saturation correction, etc. to the picture (image data) read with the scanner 12 according to the image processing condition which the conditioning part 48 mentioned later both set up. These processings are performed by publicly known methods, such as processing by LUT (look-up table), and a matrix (MTX) operation, color balance adjustment, luminosity amendment, and contrast correction are performed by LUT, and saturation correction is performed by a MTX operation.

[0032]the amendment of the aberration of a lens and the amendment of the amount fall of ambient light resulting from the image formation lens unit 32 of the taking lens of a picture, or

the scanner 12 into which the image processing portion 44B and the image processing portion 46B were read with the scanner 12, and a picture focus -- it is a portion which amends a Japanese quince. In order to distinguish a taking lens, when the film F is a disposable camera of an advanced photo system, here, for example, It reads by the magnetic head etc. in which the magnetic information recorded on the film F is provided by the career of the scanner 12 and which are not illustrated, It can distinguish using cartridge ID, a film kind, etc. by which magnetic recording was carried out, the model, i.e., the camera, of a disposable camera, "SSU INDICATOR" of the extended DX code currently optically recorded on the film can be optically read on a career, and this can be used. Since there is also a model which has a function which carries out magnetic recording of the model of camera to the film F in the camera corresponding to an advanced photo system, the camera which photoed the film F using this may be distinguished. The model of disposable camera or the model of photographing camera is heard from a customer at the time of a receptionist, An operator may input the model of camera by the keyboard 18a by recording on a memo, a package, a cartridge, a cartridge, etc. at the time of print creation, seeing this, it replaces with the model of camera, correspondence with a function key etc. and a camera is determined, and it may input using this. The model of camera may be optically printed on a film at the time of photography, this may be read, and the model of camera may be distinguished. As long as it is a disposable camera, the model of disposable camera is optically baked like the DX code at the time of manufacture, etc., or magnetic recording is carried out, and a model may be distinguished using these. As long as it is a film cartridge with an IC memory, the model of camera, etc. are electrically recorded on this IC memory, and a model may be distinguished using this.

[0033]amendment of degradation of the image quality which originates in a taking lens from the lens characteristic data division 47 later mentioned using information, including the model etc. of distinguished camera, i.e., amendment of aberration, amendment of the amount fall of ambient light, and a picture focus -- the coefficient of the correction formula used for amendment of a Japanese quince can be called, and a correction formula can be obtained from this coefficient. The amendment data created beforehand in quest of the correction amount may be called. Since the lens characteristic of the image formation lens unit 32 used for the scanner 12 is known beforehand, The coefficient of the correction formula used for the correcting operation for performing picture amendment is beforehand memorized to the lens characteristic data division 47, and whenever it performs picture amendment by the image processing portion 44B or the image processing portion 46B, the coefficient of this correction formula can be called. The amendment data created beforehand in quest of the correction amount may be called.

[0034]Although amendment of a distortion aberration and amendment of the chromatic aberration of magnification are one of amendments of the aberration resulting from a taking lens or the image formation lens unit 32 here, With a coefficient, they are obtained from the lens characteristic of a taking lens or the image formation lens unit 32 by amendment of a distortion aberration, and amendment of the chromatic aberration of magnification, and A **** correction formula, The amount of removal correction of each picture element position is calculated using the coordinates position (what pixel is it from a main pixel?) from the information on the position of image data (pixel), for example, the center of a picture, (the center of the optic axis of a taking lens). this correction amount was created beforehand -- amendment data call appearance may be carried out and image data may be amended.

[0035]A distortion aberration means the state where the picture itself is distorted to a bobbin type etc. as the picture of the lattice-like pattern photoed on the film shown in drawing 4 (a) is shown to drawing 4 (b) by the characteristic of the image formation lens unit 32 of a taking lens or the scanner 12, Amendment of a distortion aberration is amendment for returning a picture to a lattice-like pattern like drawing 4 (c) to this perverted picture using the amendment data which created the correction amount for every pixel beforehand, using the correction formula which computes a correction amount.

[0036]If the central point of a picture is made into central point O_4 as shown in drawing 4 (a), As shown in drawing 4 (b), when a distortion aberration is point symmetry and the center line of a

picture is made the surroundings of central point O_4 with center line X_4 and center line Y_4, it is axial symmetry around this center line X_4 and center line Y_4. Therefore, the correction amount for amending a distortion aberration is also point symmetry around central point O_4, and axial symmetry around center line X_4 and center line Y_4. Then, the field of 1/4 which divided imaging range $A_4B_4C_4D_4$ by center line X_4 and center line Y_4, For example, the correction amount of other fields can be defined by obtaining only the correction amount of field $A_4E_4O_4F_4$ and using axial symmetry and point symmetry. It is not limited to this but what is necessary is just to obtain a correction amount in this example, about some fields of imaging ranges, such as 1/2 of fields of an imaging range, although a correction amount is obtained about 1/4 of the fields of an imaging range.

[0037]As the chromatic aberration of magnification is shown in drawing 5 (a), when it is a picture of straight-line E_5F_5 by which the picture photoed on the film F passes along the point A_5 top of rectangle $A_5B_5C_5D_5$ of imagination, Say the state of the position of R pixel of straight-line E_5F_5, G pixel, and B pixel shifting, and starting a color shift as shown in drawing 5 (b), and with amendment of the chromatic aberration of magnification. To this picture that carried out the color shift, a correction amount is obtained using a correction formula for every picture element position, and the picture element position of R pixel, G pixel, and B pixel is corrected like drawing 5 (c) from this correction amount. For example, it is amendment for correcting the position of R pixel of straight-line E_5F_5, and B pixel on the basis of the position of G pixel. Maintenance memory of the amendment data which created the correction amount for every pixel beforehand may be carried out like amendment of a distortion aberration, this may be called if needed, and a correction amount may be obtained.

[0038]Since such the chromatic aberration of magnification is a point pair elephant around central point O_5 shown in drawing 5 (a) and it is axial symmetry around center line X_5 or center line Y_5, The correction amount of R pixel for amendment of the chromatic aberration of magnification, and the correction amount of B pixel as well as the correction amount for amendment of the above-mentioned distortion aberration, The field of 1/4 which divided the whole imaging range by center line X_5 and center line Y_5, For example, correcting operation only of the correction amount of field $A_5E_5O_5F_5$ can be carried out, it can be calculated, and the correction amount of R pixel of other fields and the correction amount of B pixel can be defined using axial symmetry or point symmetry using this. Although correcting operation is performed about 1/4 of the fields of an imaging range and a correction amount is calculated like amendment of the above-mentioned distortion aberration in this example, they may be any, as long as it is not limited to this but performs correcting operation about some fields of an imaging range. The correction amount in a distortion aberration and the chromatic aberration of magnification, Some fields of an imaging range, for example, a field as shown in drawing 4 (a), For example, the hold stores of the amendment data which performed correcting operation and calculated beforehand the correction amount of 1/4 of the fields of an imaging range like field $A_4E_4O_4F_4$ may be carried out, and it may amend by calling this amendment data if needed.

[0039]Amendment of this distortion aberration and amendment of amendment of the chromatic aberration of magnification are further processed collectively with electronic variable power processing. Namely, calculate the amount of gaps of the position of G pixel resulting from a distortion aberration, and from the position after amendment of G pixel. An appropriate position is computed for every R pixel and B pixel, the amount of gaps of the position of R pixel and B pixel to G pixel is calculated, using the information on the appropriate position of each computed pixel, image data is interpolated and electronic variable power processing of a picture is performed. In other words, by computing the amount of gaps of the picture element position by the chromatic aberration of magnification and a distortion aberration, the knowledge of in which position each pixel should be essentially is carried out, interpolating calculation of image data is

performed according to this proper position, and electronic variable power processing is performed. There is no limitation in particular in the method of electronic variable power processing, a publicly known method is available in some numbers, for example, the method of using bilinear interpolation, the method of using spline interpolation, etc. are illustrated. Thereby, amendment of the chromatic aberration of magnification and a distortion aberration and electronic variable power processing can be performed by one interpolating calculation.

[0040]The correction formula of a taking lens or the image formation lens unit 32, for example, a high order polynomial, amendment of the above-mentioned distortion aberration, and amendment of the chromatic aberration of magnification, Although amendment of the chromatic aberration of magnification and a distortion aberration and electronic variable power processing are performed using the coordinates position (what pixel is it from a main pixel?) from the information on the position of image data (pixel), for example, the center of a picture, (the center of the optic axis of a taking lens), In this case, x-y coordinates or polar coordinates may be sufficient as the position coordinate of each pixel. Limitation is not carried out to the information on a picture element position being based on the central point of a picture, Various kinds of things are available, for example, it is good the corners (upper left hand corner etc.) of a picture, and on the basis of a certain pixel (for example, pixel of the pixel number No. 1), and still better on the basis of the exterior of a picture, for example, the perforation of the film F, etc. That is, if the position of a picture (pixel) can detect relatively, various kinds of position information is available. When the center of the picture started with the mask etc. is mostly considered to be the center of the optic axis of the lens at the time of photography, various kinds of aberration (a distortion aberration, the chromatic aberration of magnification, the amount fall of ambient light, a picture focus Japanese quince) may be amended for the pixel of the center of the started picture as a center of the optic axis of a lens.

[0041]the picture focus which the image processing portion 44B and the image processing portion 46B originate in a taking lens or the image formation lens unit 32, and is produced -- amendment of a Japanese quince or the amount fall of ambient light can also be performed. For example, the amount fall of ambient light which is the target of amendment of the amount fall of ambient light, As shown in drawing 6 (a), originate in a taking lens or the image formation lens unit 32, and the nonuniformity of light volume arises, The lightness value of imaging range $A_6B_6C_6D_6$, Say the state of falling according to a 4th power of cosine rule, and as it separates from central point O_6 of an imaging range with amendment of the amount fall of ambient light. The amendment performed by obtaining the correction amount for every picture element position using the correction formula which becomes settled with the characteristic of a taking lens or the image formation lens unit 32 is said as the pixel located in the adjacent spaces of a picture so that the value (lightness value) of image data may be raised, so that the amount fall of ambient light may be canceled. The hold stores of the amendment data which asked by performing correcting operation beforehand may be carried out, this amendment data may be called if needed, and a correction amount may be obtained.

[0042]Since it has the feature of a point pair elephant around central point O_6 of a picture about the fall of the amount of ambient light as shown in drawing 6 (a), A part of imaging range $A_6B_6C_6D_6$ divided by center line X_6 or center line Y_6. For example, carry out correcting operation only of the correction amount of field $A_6E_6O_6F_6$ from a correction formula, and a correction amount is calculated, The correction amount of other fields can be defined in consideration of axial symmetry or point symmetry using this, and the picture of luminosity distribution like drawing 6 (b) which canceled the fall of the amount of ambient light mostly can be acquired. Drawing 6 (c) shows the correcting method of the amount fall of ambient light, defines the inclination of the conversion straight line I for every pixel, and amends image data from correction amount deltaI of light volume. That is, the image data before amendment of the amount fall of ambient light is changed into the amount of object light using the sensitivity of the CCD element of CCD sensor 34, and light volume is amended in quest of correction amount deltaI from the correction formula which becomes settled by the taking lens or the image

formation lens unit 32. The amended amount of object light is changed into image data, and obtains the image data after amendment. In this case, since the sensitivity (sensitivity of the signal value of the image data to light volume) of the CCD element of CCD sensor 34 differs for every pixel, the hold stores of the inclination of the conversion straight line l shown in drawing 6 (c) can be beforehand carried out for every pixel, it can call if needed, and sensitivity unevenness can be amended. Like the case of amendment of a distortion aberration, or amendment of the chromatic aberration of magnification, some fields of imaging range $A_6B_6C_6D_6$, For example, the hold stores of the amendment data which performed correcting operation and created beforehand the correction amount of 1/4 of the fields of an imaging range like field $A_6E_6O_6F_6$ may be carried out, and it may amend by calling this amendment data if needed.

[0043]In the image processing portion 44B or 46B, when the shading compensation in the data processing part 38 includes amendment of the amount fall of ambient light resulting from the image formation lens unit 32, neither the image processing portion 44B nor the amount fall of ambient light by 46B is amended so that amendment of the same amount fall of ambient light may not lap.

[0044]Although the image processing portion 44B and the image processing portion 46B perform picture amendment resulting from the image formation lens unit 32 of the taking lens of a camera, or the scanner 12 which photoed the picture, In the image processing device of this invention, in amendment of the picture in which it originated in the amendment and the image formation lens unit 32 of the picture in which it originated in the taking lens and image quality deteriorated, and image quality deteriorated, it is not restricted, but the picture in which it originated in the both sides of the taking lens and the image formation lens unit 32, and image quality deteriorated may be amended. In this case, the correction formula about a taking lens and the correction formula about the image formation lens unit 32 can be added, summarized and amended.

[0045]Thus, in the picture amendment which controls degradation of the image quality resulting from lenses, such as a taking lens and an image formation lens. Amendment data volume which lessened the number of times of correcting operation, and was created beforehand can be made less than a storage capacity required in order to hold the amendment data of the whole picture using the symmetry of degradation of the image quality in an imaging range, and efficient picture amendment can be performed.

[0046]The image processing portion 44B and the image processing portion 46B can perform color dodge processing and a sharpness process if needed. The image data by which picture amendment was carried out by the image processing portion 44B and the image processing portion 46B is sent to the data conversion part 44C and the data conversion part 46C. The data conversion part 44C changes the image data processed by the image processing portion 44B using 3D(three dimensions)-LUT etc., and makes it the image data corresponding to the display by the monitor 20. On the other hand, the data conversion part 46C is a portion which changes similarly the image data processed by the image processing portion 46B using 3D-LUT, and is supplied to the printer 16 as image data corresponding to image recording with the printer 16.

[0047]the information on the lens characteristic [data division / 47 / lens characteristic] according to the model of various kinds of cameras -- concrete -- amendment of the aberration of various kinds of lenses, amendment of the amount fall of ambient light, and a picture focus -- the coefficient of the correction formula used for amendment of a Japanese quince is memorized. A correction amount may carry out the hold stores of the amendment data called for and created beforehand. in this case, the distortion aberration and the chromatic-aberration-of-magnification characteristic of a lens, the amount distribution characteristic of ambient light, and a picture focus, since the characteristic of a Japanese quince sees from the whole imaging range and has the symmetry over an image center line, and the symmetry over an image center point, Using such symmetry, some amendment data of an imaging range, For example, as shown in drawing 4 (a), the hold stores only of the amendment data of 1/4 of field $A_4E_4O_4F_4$ of picture whole field $A_4B_4C_4D_4$ are carried out. As a result, it is farther [than a storage capacity required

in order to hold the amendment data of the field of the whole picture] few, and an amendment storage capacity is stopped, the access time concerning the call of amendment data also has a short storage capacity for holding amendment data, and it enables shortening of the processing time of image processing.

[0048]Although a correction formula and amendment data are memorized by the storage parts store of the lens characteristic data division 47 in this example, It memorizes in the database which is not restricted to this, for example, is connected to the photograph printer 10, and may access and read to ****, or may be inputted from the outside as information on the lens corresponding to a film at the time of reading of the film F.

[0049]The conditioning part 48 chooses image processing to perform, and using prescan data, sets up the image processing condition in the prescan image processing portion 44 and this scan picture treating part 46, and unifies a parameter. Specifically Creation of prescan data to a density histogram, Average concentration, LATD (large area transmittance factor density), a highlight (least concentration), According to directions of the operator using the operating system 18 which performs calculation of image characteristic quantity, such as a shadow (maximum concentration), etc., in addition is performed if needed, Image processing conditions, such as creation of the table (LUT) of gray balance adjustment, luminosity amendment, and contrast correction and creation of the matrix arithmetic which performs saturation correction, are determined. According to various kinds of directions which were inputted, a luminosity, a color, contrast, sharpness, a chroma saturation tone, etc. which were set up by the keyboard 18a compute the amounts of adjustments of an image processing condition (for example, correction amount of LUT, etc.), unify them as a parameter, and reset an image processing condition.

[0050]In the above, the composition of the processing unit 14 was explained. Hereafter, an operation of the processing unit 14 is explained.

[0051]As for each output signal of R, G, and B read with the scanner 12, amendment, a shading compensation, etc. are performed at the time of A/D (analog to digital) conversion, Log conversion, DC offset amendment, and dark. Here, since shading also changes according to the diaphragm value or zoom magnifying power of the image formation lens unit 32, a shading compensation changes the correction amount of a shading compensation according to a diaphragm value or zoom magnifying power. As shown in drawing 3, such a correction amount performs correcting operation for 1/4 of field $A_3E_3O_3F_3$ of field $A_3B_3C_3D_3$ of the whole picture for every pixel, and calculates a correction amount, Using this correction amount, using the axial symmetry nature of center line X_3, calculate the correction amount of field $O_3H_3D_3F_3$ and the axial symmetry nature of center line Y_3 is used, Calculate the correction amount of field $E_3B_3G_3O_3$ and the surrounding point symmetry nature of central point O_3 is used, The correction amount of field $O_3G_3C_3H_3$ is calculated and picture amendment of field $A_3B_3C_3D_3$ of the whole picture is performed. By calling the amendment data about the light volume which was created beforehand in quest of the correction amount, and carried out hold stores to the storage parts store which is not illustrated, a correction amount may be obtained and this may be used. In the case of a shading compensation, the scanner 12 amends image data according to the sensitivity of a CCD element in consideration of the sensitivity unevenness of the CCD element which constitutes CCD sensor 34 at the time of reading a picture in photoelectricity for every pixel.

[0052]After amendment, a shading compensation, etc. are performed at the time of A/D (analog to digital) conversion, Log conversion, DC offset amendment, and dark, prescan data is sent to the prescan memory 40.

[0053]If prescan data is sent and memorized by the prescan memory 40, the conditioning part 48 will read prescan data, will perform creation of a density histogram, calculation of image characteristic quantity, etc., and will set up an image processing condition using this (creation of LUT or MTX). The set-up image processing condition is integrated and is sent to the prescan image processing portion 44 and this scan picture treating part 46.

[0054]Various kinds of directions and information that it was inputted into the image processing

device 14 by the keyboard 18a and the mouse 18b, The magnetic information of the film F read on the career of the scanner 12 is sent, and when the information on the photoed camera is inputted, this magnetic information is sent to the lens characteristic data division 47 via the conditioning part 48. The coefficient of a correction formula is read from the acquired magnetic information as lens characteristic data, and the lens characteristic day tab 47 is sent to the image processing portion 44B. The amendment data which the correction amount was calculated beforehand and created may be read, and this may be sent to the image processing portion 44B.

[0055]Subsequently, it is read from the prescan memory 40 by prescan data, and by the LUT-MTX operation part 44A. According to the set-up image processing condition, color balance adjustment, contrast correction (gradation processing), luminosity amendment, saturation correction, etc. are performed to the prescan data read with the scanner 12, and it is sent to the image processing portion 44B.

[0056]In the image processing portion 44B, the coefficient sent from the lens characteristic data division 47, As a coefficient of a correction formula, for example, the secondary high order polynomial [3rd], give and this correction formula and the position coordinate of the pixel to amend are used, amendment and the picture focus of the distortion aberration and the chromatic aberration of magnification which calculate and calculate a correction amount and originate in the image formation lens unit 32 of a taking lens or the scanner 12 -- amendment of a Japanese quince and amendment of the amount fall of ambient light are performed. or -- using the correction amount obtained from this amendment data, when the amendment data which calculated beforehand the correction amount in each picture element position from the lens characteristic data division 47 is sent -- amendment and the picture focus of a distortion aberration or the chromatic aberration of magnification -- amendment of a Japanese quince and amendment of the amount fall of ambient light are performed. For example, as shown in drawing 4 (a), amendment of the distortion aberration in the position coordinate which makes biaxial the X-axis and the Y-axis which intersect perpendicularly mutually along the edge of an imaging range, and the chromatic aberration of magnification is made into an example, and the method of amendment of the X axial direction of the distortion aberration shown in drawing 7 and the chromatic aberration of magnification is explained.

[0057]Amendment of the X axial direction of a distortion aberration and the chromatic aberration of magnification, Position coordinate x_c and y_c of the central point of an imaging range on the basis of a certain position, for example, the position of corner point B_4 of a picture, are inputted, The position coordinate from the central point of the pixel of the imaging range which amends a distortion aberration from this, position coordinate x_i of G pixel which performs picture amendment, and y_i is searched for. On the other hand, correction formula D_{out} (x, y) of the distortion aberration expressed by the high order polynomial is obtained using the coefficient obtained by the lens characteristic data division 47, By calculating and calculating a correction amount from the position coordinate from the central point for which it asked previously, and this correction formula D_{out} (x, y), and adding this correction amount to position coordinate x_i, the distortion aberration of an X axial direction is amended and the picture element position of the X axial direction after amendment is obtained.

[0058]In the amendment of the chromatic aberration of magnification performed henceforth, G pixel serves as a standard which calculates the amount of gaps of the picture element position of R pixel and B pixel, and amendment of the chromatic aberration of magnification is not performed. Therefore, G pixel serves as a picture element position of G pixel after amendment according [the picture element position amended by amendment of the distortion aberration] to amendment of music aberration, and amendment of the chromatic aberration of magnification. On the other hand, amendment of the chromatic aberration of magnification of R pixel and B pixel, Correction formula R_{out} (x, y) and B_{out} (x, y) of the chromatic aberration of magnification which were expressed by the high order polynomial using the coefficient obtained by the lens characteristic data division 47 are obtained, By calculating the correction amount of the chromatic aberration of magnification of R pixel and B pixel, and adding the position coordinate

of the X axial direction of G pixel after amending to this using these correction formulas and the position coordinate of G pixel after the amendment to which amendment of the distortion aberration was performed. The position coordinate of the direction of X after amendment of R pixel to which amendment of a distortion aberration and the chromatic aberration of magnification was performed, and G pixel is acquired. In that case, about a distortion aberration and the chromatic aberration of magnification. As shown in drawing 4 (a) and drawing 5 (a), it is point symmetry around central point O_4 or central point O_5, Since it is furthermore axial symmetry around center line X_4, center line X_5, and center line Y_4 and center line Y_5, Perform correcting operation of each picture element position in field [equivalent to 1/4 of the whole imaging range], for example, field A_4E_4, O_4F_4, or field $A_5E_5O_5F_5$, and a correction amount is obtained, Using the above-mentioned symmetry, the correction amount in other fields is defined, the picture element position after amendment is obtained from this correction amount, and amendment of a distortion aberration and amendment of the chromatic aberration of magnification are performed. When the lens characteristic data division 47 is carrying out the hold stores of the amendment data which calculated beforehand the correction amount in each picture element position, instead of performing this correcting operation and calculating a correction amount, amendment data is used, a correction amount is obtained, and the same compensation process as a described method is performed.

[0059]Thus, in the picture amendment which controls degradation of the image quality resulting from a lens, amendment data volume which lessened the number of times of correcting operation, and was created beforehand can be made less than a storage capacity required in order to hold the amendment data of the whole picture using the symmetry of degradation of the image quality in an imaging range. In the above-mentioned example, also when calculation time is shortened by 1/4 when performing only correcting operation of the field equivalent to 1/4 of the whole imaging range, and using amendment data, the amendment data volume which carries out hold stores also drops to 1/4 compared with the case of all the imaging ranges, and efficient picture amendment can be performed. The above is amendment of the X axial direction of a distortion aberration and the chromatic aberration of magnification, and amendment of Y shaft orientations is similarly performed apart from amendment of an X axial direction.

[0060]In order to perform electronic piece double processing after that, position coordinate x_c and position coordinate y_c of the central point are inputted, R -- a pixel -- G -- a pixel -- and -- B -- a pixel -- an X axial direction -- a position coordinate -- x -- $_{iR}$ -- ' -- x -- $_{iG}$ -- ' -- and -- x -- $_{iB}$ -- ' -- obtaining -- this -- using -- an electron -- a piece -- double -- processing -- giving -- having -- a picture -- amendment -- furthermore -- an electron -- variable power processing -- carrying out -- having had -- image data -- obtaining . Then, color dodge processing and a sharpness process are performed if needed.

[0061]The image data by which the compensation process was carried out in the image processing portion 44B is sent to the data conversion part 44C, and is changed into the image data corresponding to the display by the monitor 20 using 3D(three dimensions)-LUT etc. Then, the amended prescan picture is displayed on the monitor 20.

[0062]An operator performs the check (assay) of a picture, i.e., a processing result, seeing the display of the monitor 20, and adjusts a color/concentration, gradation, etc. using said each key which were set as the keyboard 18a if needed. The input of this adjustment is sent to the conditioning part 48, computes the correction amount of the image processing condition according to an adjustment input, and according to this correction amount, as mentioned above, a compensation process is performed in the LUT-MTX operation part 44A or the image processing portion 44B, and it is again displayed on the monitor 20.

[0063]the picture as which an operator is displayed on the monitor 20 is proper -- a judgment (assay O.K.) will direct the start of this scan using the keyboard 18a etc. By this, an image processing condition is become final and conclusive, and this scanning data of high resolution is sent from the scanner 12, and like prescan image data by the data processing part 38. After

amendment, a shading compensation, etc. are performed at the time of A/D (analog to digital) conversion, Log conversion, DC offset amendment, and dark, this scanning data is sent to this scan memory 42.

[0064]Then, this scanned image data read from this scan memory 42, It is sent to this scan picture treating part 46, and like prescan data, by the LUT-MTX operation part 48, color balance adjustment, contrast correction (gradation processing), luminosity amendment, saturation correction, etc. are performed, and it is sent to the image processing portion 46B by the settled image processing condition.By the method same in the image processing portion 46B as the amendment performed by the image processing portion 44B to prescan data. amendment of the distortion aberration which originates under the settled image processing condition at the image formation lens unit 32 of a taking lens or the scanner 12, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, or a picture focus -- a Japanese quince is amended. This scanning data in which amendment was performed is sent to the data conversion part 46C, is changed into the image data which carries out a print output to the printer 16 using 3D(three dimensions)-LUT etc., and is sent to the printer 16.

[0065]The printer 16 exposes photosensitive materials (photographic paper) according to this scanning data, records a latent image, performs the development according to photosensitive materials, and outputs it as a print (result). After cutting photosensitive materials to the specified length according to a print, for example, record of a back print, According to image data (recorded image), modulate three sorts of optical beams, the red (R) exposure according to the spectral sensitivity characteristic of photosensitive materials (photographic paper), green (G) exposure, and the blue (B) exposure G, and. It deviates to a scanning direction and record etc. of the latent image by conveying photosensitive materials to the vertical scanning direction which intersects perpendicularly with a scanning direction are performed, and wet-developing processing of predetermined [, such as the color development, bleach fixing, and rinsing,] is performed, and the photosensitive materials which recorded the latent image are classified and piled up, after drying and considering it as a print. Thus, according to the characteristic of the taking lens of the camera which photoed the lens characteristic and picture of the image formation lens unit 32 which constitutes the characteristic of the optical system 33 of the scanner 12, and the optical system 33 of the scanner 12, the picture which performed picture amendment can obtain as a print.

[0066]As mentioned above, although the image processing device of this invention was explained in detail, in the range which limitation is not carried out to the above-mentioned example, and does not deviate from the gist of this invention, this invention of various kinds of improvement and change being made is natural. in addition -- setting in this invention to the image processing portion 44B of the prescan image processing portion 44, and the image processing portion 46B of this scan picture treating part 46 -- amendment of a distortion aberration, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, and a picture focus, although the Japanese quince is amended, amendment of the distortion aberration in the image processing portion 44B of the prescan image processing portion 44, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, and a picture focus -- a Japanese quince may not be amended but the above-mentioned compensation process may be performed only in the image processing portion 46B of this scan picture treating part 46. Although it was a scanner which reads a picture in photoelectricity using an area CCD sensor in this example, By slit scanning which reads a picture carrying out scanning conveyance of the film F on a career, may be a picture reading **** thing and also in this case degradation of image quality, Since it has the symmetry of the circumference of the center line of the imaging range suitable for a scanning transportation direction, picture amendment can be efficiently performed using this symmetry.

[0067]

[Effect of the Invention]As mentioned above, as explained in detail, when picture amendment which controls degradation of the image quality resulting from degradation, taking lens, and image formation lens of the image quality resulting from the optical system of an image reader etc. is performed according to this invention, Since the whole picture is amended from some correction

amounts of a picture in consideration of the object nature of the degradation condition of the picture about the central point or the center line of an imaging range, picture correction processing time can be reduced, and the amount of picture correction data can be reduced, and picture amendment can be performed efficiently.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
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TECHNICAL FIELD

[Field of the Invention]This invention is an image processing device which amends degradation of the image quality of the picture resulting from the optical system containing the taking lens which photoed the picture, and the image formation lens of an image reader, and belongs to the technical field of the image processing device which can reduce picture correction processing time and the amount of picture correction data, and can perform picture amendment efficiently.
[0002]

[Translation done.]

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PRIOR ART

[Description of the Prior Art]Now, baking to the photosensitive materials (photographic paper) of the picture photoed by photographic films (it is hereafter considered as a film), such as a negative film and a reversal film, is directly performed by what is called exposure (analog exposure) that projects the picture of a film on photosensitive materials and carries out field exposure of the photosensitive materials.
[0003]on the other hand, the printing equipment which uses digital exposure in recent years -- that is, After reading in photoelectricity the picture recorded on the film and making the read picture into a digital signal, Various image processing was performed and it was considered as the image data for record, and scanning exposure of the photosensitive materials was carried out by the recording light modulated according to this image data, the picture (latent image) was recorded, and the digital photo printer considered as a print (result) was put in practical use.
[0004]In a digital photo printer, since image data processing can determine the exposing condition at the time of printing as digital image data, a picture, The jump of a picture, amendment of TSUBURE, sharpness (sharp-izing) processing resulting from a backlight, speed light photography, etc., Amendment of color FERIA or concentration Ferrier, amendment of under exposure or exaggerated exposure, amendment of the amount fall of ambient light, etc. can be performed suitably, and the high-definition print which was not directly obtained by the conventional exposure can be obtained. And an output is possible also for composition and image division of a multiple image, and the print which could perform composition of the character, etc. by image data processing further, and was freely edited / processed according to the use. And according to the digital photo printer, a print can also be created from the picture (image data) photoed with the digital camera etc., Since it can supply image data to a computer etc. or it it not only outputs a picture as a print (photograph), but can be saved at recording media, such as a floppy (registered trademark) disk, image data can be used for various uses other than a photograph.
[0005]The scanner with which such a digital photo printer reads fundamentally the picture recorded on the film in photoelectricity (image reader), It comprises an image processing device which carries out image processing of the read picture, and is made into the image data for record, and a printer (image recorder) which carries out scanning exposure of the photosensitive materials according to this image data, performs a development, and is considered as a print.
[0006]In a scanner, enter into a film the read light ejected from the light source, and the projected light which supports the picture photoed by the film is obtained, After reading a picture and performing various kinds of image processing if needed by carrying out image formation of this projected light to image sensors, such as a CCD sensor, and carrying out photoelectric conversion with an optical system image formation lens, it sends to an image processing device as image data (image data signal) of a film. An image processing device sets up an image processing condition from the image data read with the scanner, performs image processing according to the set-up conditions to image data, and sends it to a printer as output image data (exposing condition) for image recording. In a printer, if it is a device using optical beam scanning exposure, according to the image data sent from the image processing device, modulate an optical beam, carry out scanning exposure (printed) of the photosensitive materials in two

dimensions, form a latent image, and it ranks second, for example, A predetermined development etc. are performed and it is considered as the print (photograph) in which the picture photoed by the film was reproduced.

[0007]By the way, the chromatic aberration of magnification which originates in the taking lens of the camera which photoed the picture as a cause of degradation of the image quality of the picture reproduced by the print, a distortion aberration, the amount fall of ambient light, and a picture focus -- the chromatic aberration of magnification resulting from the image formation lens [Japanese quince] of the image reader read in photoelectricity, a distortion aberration, the amount fall of ambient light, and a picture focus -- shading resulting from the optical system containing the image formation lens of a Japanese quince or an image reader is mentioned.

[0008]Although a color picture is formed of the three primary colors of red (R) green (G) and blue (B), since the refractive index (image formation magnification) of a lens changes delicately with wavelength, a color gap will produce it in the picture acquired by the image formation magnification of the light of R, G, and B differing, namely, the chromatic aberration of magnification arising. In order to obtain a proper taken image, image formation of the flat surface vertical to the optic axis in a scene needs to be carried out on the same vertical flat surface to an optic axis. However, in the usual lens, the picture from which an image formation face shifts to an optical axis direction and which was acquired by producing what is called a distortion aberration and distorting an image formation picture (producing distortion) will become what has distortion. the fall of the amount of ambient light to which a picture becomes dark rather than the central part in the periphery produced according to the performance of a taking lens or an image formation lens and the picture focus resulting from focus positions differing in the plane direction of a film -- the Japanese quince etc. cause degradation of image quality. The nonuniformity of light intensity arises in the performance of the light volume unevenness of the light source of an optical system, or an image formation lens, and the read light itself which were further ejected from the light source by the performance of the whole optical system, nonuniformity is made also to the light volume irradiated by the picture, and shading which produces density unevenness as a result also causes degradation of image quality.

[0009]Like a single lens reflex camera, if it is a camera which can hang a certain amount of cost, the image quality deterioration of the picture resulting from a taking lens can be controlled by combining two or more more lenses using a high-precision taking lens. If an image reader can hang cost to some extent, degradation of the picture resulting from the optical system containing an image formation lens can be controlled by using an optical system precise again by combining two or more more lenses using a high-precision image formation lens. However, in a disposable camera or a cheap compact camera. since cost cannot be hung on a lens and cost cannot be hung so much on an image formation lens, an optical system, etc. in a simple and small image reader -- a picture -- the fall of the chromatic aberration of magnification, a distortion aberration, and the amount of ambient light, and a picture focus -- a Japanese quince and shading will arise. As a result, the problem used as the picture in which image quality deteriorated produces the picture reproduced as a print.

[0010]To such a problem, the information about a taking lens, etc. were acquired and the photographic processing device which judges degradation of image quality based on acquisition information, and amends degradation of the image quality of a picture based on the judged degradation state is proposed so that it may be mentioned to JP,9-281613,A. In the above-mentioned photographic processing device, the degradation state of the image quality of a picture is judged based on the information about the acquired taking lens, etc., a fall and picture focus of the chromatic aberration of magnification of the picture which amends the whole picture in quest of the correction amount of the whole picture according to judgment, and originates in a taking lens, a distortion aberration, and the amount of ambient light -- a Japanese quince can be amended.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention]As mentioned above, as explained in detail, when picture amendment which controls degradation of the image quality which originates in degradation, taking lens, and image formation lens of the image quality resulting from the optical system of an image reader etc. in this invention is performed, In consideration of the object nature of the degradation condition of the picture about the central point or the center line of an imaging range, the whole picture is amended from some correction amounts of a picture.
Therefore, picture correction processing time can be reduced, and the amount of picture correction data can be reduced, and picture amendment can be performed efficiently.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]by the way, a fall and picture focus of the chromatic aberration of magnification of the picture which originates in a taking lens in the above-mentioned photographic processing device, a distortion aberration, and the amount of ambient light -- since the whole picture is amended by calculating a correction amount over the whole picture when amending a Japanese quince, it is necessary to calculate a correction amount for every pixel Depending on the size of a picture, a correction amount must be calculated for every pixel also, for example from big image data like image data (2000 pixels x 1000 pixels). Therefore, the problem that the processing time which calculates and calculates a correction amount for every pixel will increase arose. Although carrying out the hold stores of the amendment data which calculated beforehand the correction amount for amending to image data for every pixel for every pixel of a picture is also considered, According to big image data, it became large, the reading time of amendment data also started, and efficient picture amendment could not be performed, but the problem that a simple and small image reader was unrealizable also produced the storage capacity required for amendment data.
[0012]In the above-mentioned photographic processing device, the degradation state of the image quality of a picture is judged based on the information about a taking lens, etc., the picture is only amended according to judgment, and degradation of the image quality resulting from the image formation lens or optical system of a simple image reader cannot be controlled.
[0013]Then, in the image processing device which performs picture amendment for the image data of the picture photoed optically as image data for an input, and obtains the image data for an output in order that this invention may solve the above-mentioned problem, When performing picture amendment which corrects degradation of the image quality of the picture resulting from the optical system containing the taking lens which photoed the picture, and the image formation lens of an image reader, reduce picture correction processing time and the amount of picture correction data is reduced, It aims at providing the image processing device which can perform picture amendment efficiently.

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MEANS

[Means for Solving the Problem]To achieve the above objects, this invention is an image processing device which amends to image data of a picture formed optically, It has a compensation means which performs picture amendment which amends degradation of image quality to image data, and an image processing device, wherein this compensation means amends the whole picture from some correction amounts of said picture using the object nature of degradation of image quality about the central point or a center line of an imaging range is provided.
[0015]As for said compensation means, it is preferred in that case to amend degradation of image quality resulting from an optical system of image reading at the time of obtaining degradation or said image data of image quality resulting from a taking lens which photoed said picture, Picture amendment which amends degradation of image quality resulting from said taking lens, amendment of a distortion aberration resulting from said taking lens, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, and a picture focus -- it being at least one of amendments of a Japanese quince, and, Picture amendment which amends degradation of image quality resulting from an optical system of said image reading, Amendment of shading resulting from an optical system, amendment of a distortion aberration resulting from an image formation lens of said optical system, a picture focus resulting from amendment of the chromatic aberration of magnification resulting from said image formation lens, amendment of the amount fall of ambient light resulting from said image formation lens, and said image formation lens -- it is preferred that it is at least one of amendments of a Japanese quince.
[0016]As for said compensation means, it is preferred to calculate and calculate some correction amounts of said picture from a correction function, and to amend the whole picture using this correction amount, and said compensation means, In consideration of object nature to a center position or a center line of a picture of said correction function, amendment data which calculated some correction amounts of a picture beforehand may be held, and the whole picture may be amended using this amendment data. In that case, few things are more preferred than a storage capacity which needs capacity of a storage parts store for holding said amendment data in order to hold amendment data of the whole picture. As for said shading compensation, in order to read image data in photoelectricity, it is preferred to amend by using with read sensitivity for every pixel at the time of reading in photoelectricity a correction amount of light volume nonuniformity which becomes settled from a diaphragm value or zoom magnifying power of an optical system lens to which image formation of the picture photoed by film is carried out.
[0017]
[Embodiment of the Invention]Hereafter, the image processing device of this invention is explained in detail based on the preferred embodiment shown in an attached drawing.
[0018]The block diagram of an example of the digital photo printer 10 provided with the image processing device of this invention is shown in drawing 1. The digital photo printer (it is hereafter considered as the photograph printer 10) shown in drawing 1, The scanner (image reader) 12 which

reads fundamentally the picture photoed by the film F in photoelectricity, The image processing device 14 which performs image processing of image data, operation, control of the photograph printer 10 whole which were read, It has the printer 16 which carries out image exposure of the photosensitive materials (photographic paper), carries out a development, and is outputted as a print (result), and comprises an optical beam modulated according to the image data outputted from the image processing device 14. The operating system 18 which has the keyboard 18a and the mouse 18b for inputting directions of the input (setting out) of various conditions, selection of processing and directions, a color/density correction, etc., etc., etc. into the image processing device 14, The monitor 20 which displays the picture read with the scanner 12, various kinds of operator guidance, setting out/registration picture of various conditions, etc. is connected.

[0019]The scanner 12 is a device which reads at a time in photoelectricity one top of pictures photoed by the film F etc., The colored filter board 26 which has a colored filter of three sheets of the light source 22, the variable aperture 24, R for decomposing a picture into the three primary colors of R (red), G (green), and B (blue), G, and B, rotates and acts arbitrary colored filters on an optical path, The diffusion box 28 which makes uniform read light which enters into the film F in the plane direction of the film F, The image formation lens unit 32 and CCD sensor 34 which is the area sensors which read the picture of one top of a film, It has the amplifier (amplifier) 36, and is constituted and the light source 22, the variable aperture 24, the colored filter board 26, the diffusion box 28, and the image formation lens unit 32 form the optical system 33.

[0020]In the photograph printer 10 of the example of a graphic display, The kinds and sizes of a film, such as an advanced photo system (Advanced Photo System) and a negative (or reversal) film of 135 sizes, According to the kind of processing of the gestalt of films, such as SUTORIPPUSU and a slide, trimming, etc., etc., the career for exclusive use with which the main part of the scanner 12 can be equipped freely is prepared, and it can respond to various kinds of films or processing by exchanging careers. The picture (top) which is photoed by the film and with which print creation is presented is conveyed and held by this career in a predetermined reading station. As everyone knows, a magnetic recording medium is formed in the film of an advanced photo system, and cartridge ID, a film kind, etc. are recorded on it, and various kinds of data of the kind of the camera and developing machine which were used for a photographing date and photography, etc. can be recorded at the time of photography and development, etc. The reading means of this magnetic information is arranged, on the career corresponding to the film (cartridge) of an advanced photo system, when conveying a film to a reading station, magnetic information is read, and said various kinds of information is sent to the image processing device 14.

[0021]In such a scanner 12, it is ejected from the light source 22 and light volume adjustment is carried out by the variable aperture 24, The colored filter board 26 is passed, and color adjustment is carried out, and when the read light diffused in the diffusion box 28 enters and penetrates for one top of the film F held in the predetermined reading station with a career, the projected light which supports the picture of this top photoed by the film F is obtained. Image formation of the projected light of the film F is carried out to the acceptance surface of CCD sensor 34 by the image formation lens unit 32, it is read in photoelectricity, the output signal is amplified by CCD sensor 34 with the amplifier 36, and it is sent to the image processing device 14 by it. CCD sensor 34 is a 1380x920-pixel area CCD sensor, for example.

[0022]In the scanner 12, by inserting each colored filter of the colored filter board 26 one by one, and performing such image reading 3 times, it decomposes into the three primary colors of R, G, and B, and the picture of one top is read. Here, in the photograph printer 10, in order to determine an image processing condition etc. in advance of the image reading (this scan) for outputting a print, the prescan which reads a picture with a low resolution is performed. Therefore, a total of 6 times of image reading are performed with one top.

[0023]Although the scanner 12 decomposed projected light into the three primary colors and has read the picture with the colored filter board 26 using the area CCD sensor, As a scanner used for

this invention, slit scanning which reads a picture may perform image reading using three sorts of line CCD sensors corresponding to each trichromatic reading, carrying out scanning conveyance of the film F on a career.

[0024]Although the photograph printer 10 of the example of a graphic display is using as the image data supply source of the image processing device 14 the scanner 12 which reads in photoelectricity the picture photoed by films, such as a negative and reversal, As an image data supply source which supplies image data to the image processing device 14, Imaging devices which read the picture of a reflection copy besides scanner 12, such as an image reader, a digital camera, and a digital camcorder, It is usable in some numbers in various kinds of image read means and imaging means, such as media (recording medium), such as a means of communication of LAN (Local Area Network), a computer communication network, etc., a memory card, and MO (optical magnetic recording medium), the memory measure of image data, etc. In this invention, the picture acquired from these means should just be photoed optically at least.

[0025]The output signal (image data) from the scanner 12 is outputted to the image processing device 14. The block diagram of an image processing device (it is hereafter considered as the processing unit 14) is shown in drawing 2. The processing unit 14 has the data processing part 38, the prescan (frame) memory 40, this scanning (frame) memory 42, the prescan image processing portion 44, this scan picture treating part 46, and the conditioning part 48, and is constituted. Drawing 2 mainly shows an image-processing-related part and to the processing unit 14. CPU which performs control and management of the photograph printer 10 whole which contains the processing unit 14 besides this, The memory which memorizes information required for the operation of the photograph printer 10, etc., a means to determine the diaphragm value (diaphragm value of the image formation lens unit 32) of the variable aperture 24 in the case of this scan and the storage time of CCD sensor 34, etc. are arranged, The operating system 18 and the monitor 20 are connected to each part via this CPU (CPU bus).

[0026]Each output signal of R, G, and B with which the data processing part 38 was outputted from the scanner 12 is A/D (analog to digital) conversion, Log conversion, DC offset amendment, and a portion that performs amendment, a shading compensation, etc. at the time of dark. In the photograph printer 10, when it is difficult to hang cost, for example on the diffusion box 28 or image formation lens unit 32 grade, and to make the precise optical system 33 form, it is easy to generate the nonuniformity of the light intensity of shading, i.e., irradiation light. For example, near an image center, luminous intensity is strong, and luminous intensity is weak in the circumference. The strength of such a light originates in the optical system 33 whole including the optical system 33 22 of the diffusion box 28 or not only the image formation lens unit 32 but the scanner 12, i.e., a light source, the variable aperture 24, or colored filter board 26 grade, and is generated. Therefore, in such a photograph printer 10, it is necessary to perform a shading compensation proper so that the picture by almost uniform light volume can be acquired by adjusting the brightness of a picture from the correction amount of light volume. In order to change with the diaphragm values or zoom magnifying power of the image formation lens unit 32, shading is constituted so that the correction amount of a shading compensation may also change according to a diaphragm value or zoom magnifying power.

[0027]The correction amount of such a shading compensation is defined as a correction amount of light volume, and calculates the correction amount according to a diaphragm value or zoom magnifying power from the correction function which becomes settled according to a diaphragm value or zoom magnifying power, for example, the secondary high order polynomial [3rd], for every picture element position. As shown in drawing 3, in that case shading, In order to equip mostly with the feature of point symmetry the surroundings of center line X_3 of the imaging range shown in drawing 3, and center line Y_3 around axial symmetry and central point O_3, Using this symmetry, perform correcting operation for 1/4 of field $A_3E_3O_3F_3$ of field $A_3B_3C_3D_3$ of the whole picture for

every pixel, and a correction amount is calculated, The hold stores of the amendment data which comprises the correction amount of field $A_3E_3O_3F_3$ are carried out to the storage parts store which creates beforehand and is not illustrated, Call amendment data if needed, obtain a correction amount, and this correction amount is used, Picture amendment of the whole picture can be performed by carrying out picture amendment of the field $E_3B_3G_3O_3$ which becomes other field, for example, field, $A_3E_3O_3F_3$, center line Y_3, and axial symmetry. Thus, using the symmetry of shading which should be amended, the number of times of correcting operation can be lessened, and amendment data volume can be made less than a storage capacity required in order to hold the amendment data of the whole picture, and an efficient shading compensation can be performed.

[0028]Hold stores may be beforehand carried out to a storage parts store for every pixel by using the correction amount according to a diaphragm value or zoom magnifying power as amendment data, this amendment data may be called if needed, and a correction amount may be obtained. The correction amount for a shading compensation, Since it is a correction amount about light volume, the data which carried out the hold stores of the read sensitivity for every pixel beforehand with the scanner 12 in consideration of the sensitivity unevenness of the CCD element which constitutes CCD sensor 34 at the time of reading a picture in photoelectricity is called, and image data is amended according to the sensitivity of a CCD element.

[0029]In the data processing part 38, the picture signal by a prescan and a picture signal with this scan, It is processed, and it is considered as prescan data and this scanning data, and prescan data is used as the prescan memory 40, and this scanning data is memorized by this scan memory 42, respectively (storing). Prescan data and this scanning data are the same data fundamentally, except that resolution (picture element density) differs from a signal level.

[0030]This scanning data in which the prescan data memorized by the prescan memory 40 was memorized by this scan memory 42 in the prescan image processing portion 44 is processed in this scan picture treating part 46, respectively. The prescan image processing portion 44 has the LUT-MTX operation part 44A, the image processing portion 44B, and the data conversion part 44C, and is constituted. On the other hand, this scan picture treating part 46 has the LUT-MTX operation part 46A, the image processing portion 46B, and the data conversion part 46C, and is constituted.

[0031]The LUT-MTX operation part 44A and the LUT-MTX operation part 46A, It is a portion which performs color balance adjustment, contrast correction (gradation processing), luminosity amendment, saturation correction, etc. to the picture (image data) read with the scanner 12 according to the image processing condition which the conditioning part 48 mentioned later both set up. These processings are performed by publicly known methods, such as processing by LUT (look-up table), and a matrix (MTX) operation, color balance adjustment, luminosity amendment, and contrast correction are performed by LUT, and saturation correction is performed by a MTX operation.

[0032]the amendment of the aberration of a lens and the amendment of the amount fall of ambient light resulting from the image formation lens unit 32 of the taking lens of a picture, or the scanner 12 into which the image processing portion 44B and the image processing portion 46B were read with the scanner 12, and a picture focus -- it is a portion which amends a Japanese quince. In order to distinguish a taking lens, when the film F is a disposable camera of an advanced photo system, here, for example, It reads by the magnetic head etc. in which the magnetic information recorded on the film F is provided by the career of the scanner 12 and which are not illustrated. It can distinguish using cartridge ID, a film kind, etc. by which magnetic recording was carried out, the model, i.e., the camera, of a disposable camera, "SSU INDICATOR" of the extended DX code currently optically recorded on the film can be optically read on a career, and this can be used. Since there is also a model which has a function which carries out magnetic recording of the model of camera to the film F in the camera corresponding to an advanced photo system, the camera which photoed the film F using this may be distinguished. The model of disposable camera or the

model of photographing camera is heard from a customer at the time of a receptionist, An operator may input the model of camera by the keyboard 18a by recording on a memo, a package, a cartridge, a cartridge, etc. at the time of print creation, seeing this, it replaces with the model of camera, correspondence with a function key etc. and a camera is determined, and it may input using this. The model of camera may be optically printed on a film at the time of photography, this may be read, and the model of camera may be distinguished. As long as it is a disposable camera, the model of disposable camera is optically baked like the DX code at the time of manufacture, etc., or magnetic recording is carried out, and a model may be distinguished using these. As long as it is a film cartridge with an IC memory, the model of camera, etc. are electrically recorded on this IC memory, and a model may be distinguished using this.

[0033]amendment of degradation of the image quality which originates in a taking lens from the lens characteristic data division 47 later mentioned using information, including the model etc. of distinguished camera, i.e., amendment of aberration, amendment of the amount fall of ambient light, and a picture focus -- the coefficient of the correction formula used for amendment of a Japanese quince can be called, and a correction formula can be obtained from this coefficient. The amendment data created beforehand in quest of the correction amount may be called. Since the lens characteristic of the image formation lens unit 32 used for the scanner 12 is known beforehand, The coefficient of the correction formula used for the correcting operation for performing picture amendment is beforehand memorized to the lens characteristic data division 47, and whenever it performs picture amendment by the image processing portion 44B or the image processing portion 46B, the coefficient of this correction formula can be called. The amendment data created beforehand in quest of the correction amount may be called.

[0034]Although amendment of a distortion aberration and amendment of the chromatic aberration of magnification are one of amendments of the aberration resulting from a taking lens or the image formation lens unit 32 here, With a coefficient, they are obtained from the lens characteristic of a taking lens or the image formation lens unit 32 by amendment of a distortion aberration, and amendment of the chromatic aberration of magnification, and A **** correction formula, The amount of removal correction of each picture element position is calculated using the coordinates position (what pixel is it from a main pixel?) from the information on the position of image data (pixel), for example, the center of a picture, (the center of the optic axis of a taking lens). this correction amount was created beforehand -- amendment data call appearance may be carried out and image data may be amended.

[0035]A distortion aberration means the state where the picture itself is distorted to a bobbin type etc. as the picture of the lattice-like pattern photoed on the film shown in drawing 4 (a) is shown to drawing 4 (b) by the characteristic of the image formation lens unit 32 of a taking lens or the scanner 12, Amendment of a distortion aberration is amendment for returning a picture to a lattice-like pattern like drawing 4 (c) to this perverted picture using the amendment data which created the correction amount for every pixel beforehand, using the correction formula which computes a correction amount.

[0036]If the central point of a picture is made into central point O_4 as shown in drawing 4 (a), As shown in drawing 4 (b), when a distortion aberration is point symmetry and the center line of a picture is made the surroundings of central point O_4 with center line X_4 and center line Y_4, it is axial symmetry around this center line X_4 and center line Y_4. Therefore, the correction amount for amending a distortion aberration is also point symmetry around central point O_4, and axial symmetry around center line X_4 and center line Y_4. Then, the field of 1/4 which divided imaging range $A_4B_4C_4D_4$ by center line X_4 and center line Y_4, For example, the correction amount of other fields can be defined by obtaining only the correction amount of field $A_4E_4O_4F_4$ and using axial symmetry and point symmetry. It is not limited to this but what is necessary is just to obtain a correction

amount in this example, about some fields of imaging ranges, such as 1/2 of fields of an imaging range, although a correction amount is obtained about 1/4 of the fields of an imaging range.
[0037]As the chromatic aberration of magnification is shown in drawing 5 (a), when it is a picture of straight-line E_5F_5 by which the picture photoed on the film F passes along the point A_5 top of rectangle $A_5B_5C_5D_5$ of imagination, Say the state of the position of R pixel of straight-line E_5F_5, G pixel, and B pixel shifting, and starting a color shift as shown in drawing 5 (b), and with amendment of the chromatic aberration of magnification. To this picture that carried out the color shift, a correction amount is obtained using a correction formula for every picture element position, and the picture element position of R pixel, G pixel, and B pixel is corrected like drawing 5 (c) from this correction amount. For example, it is amendment for correcting the position of R pixel of straight-line E_5F_5, and B pixel on the basis of the position of G pixel. Maintenance memory of the amendment data which created the correction amount for every pixel beforehand may be carried out like amendment of a distortion aberration, this may be called if needed, and a correction amount may be obtained.
[0038]Since such the chromatic aberration of magnification is a point pair elephant around central point O_5 shown in drawing 5 (a) and it is axial symmetry around center line X_5 or center line Y_5, The correction amount of R pixel for amendment of the chromatic aberration of magnification, and the correction amount of B pixel as well as the correction amount for amendment of the above-mentioned distortion aberration, The field of 1/4 which divided the whole imaging range by center line X_5 and center line Y_5, For example, correcting operation only of the correction amount of field $A_5E_5O_5F_5$ can be carried out, it can be calculated, and the correction amount of R pixel of other fields and the correction amount of B pixel can be defined using axial symmetry or point symmetry using this. Although correcting operation is performed about 1/4 of the fields of an imaging range and a correction amount is calculated like amendment of the above-mentioned distortion aberration in this example, they may be any, as long as it is not limited to this but performs correcting operation about some fields of an imaging range. The correction amount in a distortion aberration and the chromatic aberration of magnification, Some fields of an imaging range, for example, a field as shown in drawing 4 (a), For example, the hold stores of the amendment data which performed correcting operation and calculated beforehand the correction amount of 1/4 of the fields of an imaging range like field $A_4E_4O_4F_4$ may be carried out, and it may amend by calling this amendment data if needed.
[0039]Amendment of this distortion aberration and amendment of amendment of the chromatic aberration of magnification are further processed collectively with electronic variable power processing. Namely, calculate the amount of gaps of the position of G pixel resulting from a distortion aberration, and from the position after amendment of G pixel. An appropriate position is computed for every R pixel and B pixel, the amount of gaps of the position of R pixel and B pixel to G pixel is calculated, using the information on the appropriate position of each computed pixel, image data is interpolated and electronic variable power processing of a picture is performed. In other words, by computing the amount of gaps of the picture element position by the chromatic aberration of magnification and a distortion aberration, the knowledge of in which position each pixel should be essentially is carried out, interpolating calculation of image data is performed according to this proper position, and electronic variable power processing is performed. There is no limitation in particular in the method of electronic variable power processing, a publicly known method is available in some numbers, for example, the method of using bilinear interpolation, the method of using spline interpolation, etc. are illustrated. Thereby, amendment of the chromatic aberration of magnification and a distortion aberration and electronic variable power processing can be performed by one interpolating calculation.
[0040]The correction formula of a taking lens or the image formation lens unit 32, for example, a

high order polynomial, amendment of the above-mentioned distortion aberration, and amendment of the chromatic aberration of magnification, Although amendment of the chromatic aberration of magnification and a distortion aberration and electronic variable power processing are performed using the coordinates position (what pixel is it from a main pixel?) from the information on the position of image data (pixel), for example, the center of a picture, (the center of the optic axis of a taking lens), In this case, x-y coordinates or polar coordinates may be sufficient as the position coordinate of each pixel. Limitation is not carried out to the information on a picture element position being based on the central point of a picture, Various kinds of things are available, for example, it is good the corners (upper left hand corner etc.) of a picture, and on the basis of a certain pixel (for example, pixel of the pixel number No. 1), and still better on the basis of the exterior of a picture, for example, the perforation of the film F, etc. That is, if the position of a picture (pixel) can detect relatively, various kinds of position information is available. When the center of the picture started with the mask etc. is mostly considered to be the center of the optic axis of the lens at the time of photography, various kinds of aberration (a distortion aberration, the chromatic aberration of magnification, the amount fall of ambient light, a picture focus Japanese quince) may be amended for the pixel of the center of the started picture as a center of the optic axis of a lens.

[0041]the picture focus which the image processing portion 44B and the image processing portion 46B originate in a taking lens or the image formation lens unit 32, and is produced -- amendment of a Japanese quince or the amount fall of ambient light can also be performed. For example, the amount fall of ambient light which is the target of amendment of the amount fall of ambient light, As shown in drawing 6 (a), originate in a taking lens or the image formation lens unit 32, and the nonuniformity of light volume arises, The lightness value of imaging range $A_6B_6C_6D_6$, Say the state of falling according to a 4th power of cosine rule, and as it separates from central point O_6 of an imaging range with amendment of the amount fall of ambient light. The amendment performed by obtaining the correction amount for every picture element position using the correction formula which becomes settled with the characteristic of a taking lens or the image formation lens unit 32 is said as the pixel located in the adjacent spaces of a picture so that the value (lightness value) of image data may be raised, so that the amount fall of ambient light may be canceled. The hold stores of the amendment data which asked by performing correcting operation beforehand may be carried out, this amendment data may be called if needed, and a correction amount may be obtained.

[0042]Since it has the feature of a point pair elephant around central point O_6 of a picture about the fall of the amount of ambient light as shown in drawing 6 (a), A part of imaging range $A_6B_6C_6D_6$ divided by center line X_6 or center line Y_6. For example, carry out correcting operation only of the correction amount of field $A_6E_6O_6F_6$ from a correction formula, and a correction amount is calculated, The correction amount of other fields can be defined in consideration of axial symmetry or point symmetry using this, and the picture of luminosity distribution like drawing 6 (b) which canceled the fall of the amount of ambient light mostly can be acquired. Drawing 6 (c) shows the correcting method of the amount fall of ambient light, defines the inclination of the conversion straight line I for every pixel, and amends image data from correction amount deltaI of light volume. That is, the image data before amendment of the amount fall of ambient light is changed into the amount of object light using the sensitivity of the CCD element of CCD sensor 34, and light volume is amended in quest of correction amount deltaI from the correction formula which becomes settled by the taking lens or the image formation lens unit 32. The amended amount of object light is changed into image data, and obtains the image data after amendment. In this case, since the sensitivity (sensitivity of the signal value of the image data to light volume) of the CCD element of CCD sensor 34 differs for every pixel, the hold stores of the inclination of the conversion straight line I shown in drawing 6 (c) can be beforehand carried out for every pixel, it can call if needed, and

sensitivity unevenness can be amended. Like the case of amendment of a distortion aberration, or amendment of the chromatic aberration of magnification, some fields of imaging range $A_6B_6C_6D_6$, For example, the hold stores of the amendment data which performed correcting operation and created beforehand the correction amount of 1/4 of the fields of an imaging range like field $A_6E_6O_6F_6$ may be carried out, and it may amend by calling this amendment data if needed.

[0043]In the image processing portion 44B or 46B, when the shading compensation in the data processing part 38 includes amendment of the amount fall of ambient light resulting from the image formation lens unit 32, neither the image processing portion 44B nor the amount fall of ambient light by 46B is amended so that amendment of the same amount fall of ambient light may not lap.

[0044]Although the image processing portion 44B and the image processing portion 46B perform picture amendment resulting from the image formation lens unit 32 of the taking lens of a camera, or the scanner 12 which photoed the picture, In the image processing device of this invention, in amendment of the picture in which it originated in the amendment and the image formation lens unit 32 of the picture in which it originated in the taking lens and image quality deteriorated, and image quality deteriorated, it is not restricted, but the picture in which it originated in the both sides of the taking lens and the image formation lens unit 32, and image quality deteriorated may be amended. In this case, the correction formula about a taking lens and the correction formula about the image formation lens unit 32 can be added, summarized and amended.

[0045]Thus, in the picture amendment which controls degradation of the image quality resulting from lenses, such as a taking lens and an image formation lens. Amendment data volume which lessened the number of times of correcting operation, and was created beforehand can be made less than a storage capacity required in order to hold the amendment data of the whole picture using the symmetry of degradation of the image quality in an imaging range, and efficient picture amendment can be performed.

[0046]The image processing portion 44B and the image processing portion 46B can perform color dodge processing and a sharpness process if needed. The image data by which picture amendment was carried out by the image processing portion 44B and the image processing portion 46B is sent to the data conversion part 44C and the data conversion part 46C. The data conversion part 44C changes the image data processed by the image processing portion 44B using 3D(three dimensions)-LUT etc., and makes it the image data corresponding to the display by the monitor 20. On the other hand, the data conversion part 46C is a portion which changes similarly the image data processed by the image processing portion 46B using 3D-LUT, and is supplied to the printer 16 as image data corresponding to image recording with the printer 16.

[0047]the information on the lens characteristic [data division / 47 / lens characteristic] according to the model of various kinds of cameras -- concrete -- amendment of the aberration of various kinds of lenses, amendment of the amount fall of ambient light, and a picture focus -- the coefficient of the correction formula used for amendment of a Japanese quince is memorized. A correction amount may carry out the hold stores of the amendment data called for and created beforehand. in this case, the distortion aberration and the chromatic-aberration-of-magnification characteristic of a lens, the amount distribution characteristic of ambient light, and a picture focus, since the characteristic of a Japanese quince sees from the whole imaging range and has the symmetry over an image center line, and the symmetry over an image center point, Using such symmetry, some amendment data of an imaging range, For example, as shown in drawing 4 (a), the hold stores only of the amendment data of 1/4 of field $A_4E_4O_4F_4$ of picture whole field $A_4B_4C_4D_4$ are carried out. As a result, it is farther [than a storage capacity required in order to hold the amendment data of the field of the whole picture] few, and an amendment storage capacity is stopped, the access time concerning the call of amendment data also has a short storage capacity for holding amendment data, and it enables shortening of the processing time of image processing.

[0048]Although a correction formula and amendment data are memorized by the storage parts store

of the lens characteristic data division 47 in this example, It memorizes in the database which is not restricted to this, for example, is connected to the photograph printer 10, and may access and read to ****, or may be inputted from the outside as information on the lens corresponding to a film at the time of reading of the film F.

[0049]The conditioning part 48 chooses image processing to perform, and using prescan data, sets up the image processing condition in the prescan image processing portion 44 and this scan picture treating part 46, and unifies a parameter. Specifically Creation of prescan data to a density histogram, Average concentration, LATD (large area transmittance factor density), a highlight (least concentration), According to directions of the operator using the operating system 18 which performs calculation of image characteristic quantity, such as a shadow (maximum concentration), etc., in addition is performed if needed, Image processing conditions, such as creation of the table (LUT) of gray balance adjustment, luminosity amendment, and contrast correction and creation of the matrix arithmetic which performs saturation correction, are determined. According to various kinds of directions which were inputted, a luminosity, a color, contrast, sharpness, a chroma saturation tone, etc. which were set up by the keyboard 18a compute the amounts of adjustments of an image processing condition (for example, correction amount of LUT, etc.), unify them as a parameter, and reset an image processing condition.

[0050]In the above, the composition of the processing unit 14 was explained. Hereafter, an operation of the processing unit 14 is explained.

[0051]As for each output signal of R, G, and B read with the scanner 12, amendment, a shading compensation, etc. are performed at the time of A/D (analog to digital) conversion, Log conversion, DC offset amendment, and dark. Here, since shading also changes according to the diaphragm value or zoom magnifying power of the image formation lens unit 32, a shading compensation changes the correction amount of a shading compensation according to a diaphragm value or zoom magnifying power. As shown in drawing 3, such a correction amount performs correcting operation for 1/4 of field $A_3E_3O_3F_3$ of field $A_3B_3C_3D_3$ of the whole picture for every pixel, and calculates a correction amount, Using this correction amount, using the axial symmetry nature of center line X_3, calculate the correction amount of field $O_3H_3D_3F_3$ and the axial symmetry nature of center line Y_3 is used, Calculate the correction amount of field $E_3B_3G_3O_3$ and the surrounding point symmetry-nature of central point O_3 is used, The correction amount of field $O_3G_3C_3H_3$ is calculated and picture amendment of field $A_3B_3C_3D_3$ of the whole picture is performed. By calling the amendment data about the light volume which was created beforehand in quest of the correction amount, and carried out hold stores to the storage parts store which is not illustrated, a correction amount may be obtained and this may be used. In the case of a shading compensation, the scanner 12 amends image data according to the sensitivity of a CCD element in consideration of the sensitivity unevenness of the CCD element which constitutes CCD sensor 34 at the time of reading a picture in photoelectricity for every pixel.

[0052]After amendment, a shading compensation, etc. are performed at the time of A/D (analog to digital) conversion, Log conversion, DC offset amendment, and dark, prescan data is sent to the prescan memory 40.

[0053]If prescan data is sent and memorized by the prescan memory 40, the conditioning part 48 will read prescan data, will perform creation of a density histogram, calculation of image characteristic quantity, etc., and will set up an image processing condition using this (creation of LUT or MTX). The set-up image processing condition is integrated and is sent to the prescan image processing portion 44 and this scan picture treating part 46.

[0054]Various kinds of directions and information that it was inputted into the image processing device 14 by the keyboard 18a and the mouse 18b, The magnetic information of the film F read on the career of the scanner 12 is sent, and when the information on the photoed camera is inputted,

this magnetic information is sent to the lens characteristic data division 47 via the conditioning part 48. The coefficient of a correction formula is read from the acquired magnetic information as lens characteristic data, and the lens characteristic day tab 47 is sent to the image processing portion 44B. The amendment data which the correction amount was calculated beforehand and created may be read, and this may be sent to the image processing portion 44B.

[0055]Subsequently, it is read from the prescan memory 40 by prescan data, and by the LUT-MTX operation part 44A. According to the set-up image processing condition, color balance adjustment, contrast correction (gradation processing), luminosity amendment, saturation correction, etc. are performed to the prescan data read with the scanner 12, and it is sent to the image processing portion 44B.

[0056]In the image processing portion 44B, the coefficient sent from the lens characteristic data division 47, As a coefficient of a correction formula, for example, the secondary high order polynomial [3rd], give and this correction formula and the position coordinate of the pixel to amend are used, amendment and the picture focus of the distortion aberration and the chromatic aberration of magnification which calculate and calculate a correction amount and originate in the image formation lens unit 32 of a taking lens or the scanner 12 -- amendment of a Japanese quince and amendment of the amount fall of ambient light are performed. or -- using the correction amount obtained from this amendment data, when the amendment data which calculated beforehand the correction amount in each picture element position from the lens characteristic data division 47 is sent -- amendment and the picture focus of a distortion aberration or the chromatic aberration of magnification -- amendment of a Japanese quince and amendment of the amount fall of ambient light are performed. For example, as shown in drawing 4 (a), amendment of the distortion aberration in the position coordinate which makes biaxial the X-axis and the Y-axis which intersect perpendicularly mutually along the edge of an imaging range, and the chromatic aberration of magnification is made into an example, and the method of amendment of the X axial direction of the distortion aberration shown in drawing 7 and the chromatic aberration of magnification is explained.

[0057]Amendment of the X axial direction of a distortion aberration and the chromatic aberration of magnification, Position coordinate x_c and y_c of the central point of an imaging range on the basis of a certain position, for example, the position of corner point B_4 of a picture, are inputted, The position coordinate from the central point of the pixel of the imaging range which amends a distortion aberration from this, position coordinate x_i of G pixel which performs picture amendment, and y_i is searched for. On the other hand, correction formula D_{out} (x, y) of the distortion aberration expressed by the high order polynomial is obtained using the coefficient obtained by the lens characteristic data division 47, By calculating and calculating a correction amount from the position coordinate from the central point for which it asked previously, and this correction formula D_{out} (x, y), and adding this correction amount to position coordinate x_i, the distortion aberration of an X axial direction is amended and the picture element position of the X axial direction after amendment is obtained.

[0058]In the amendment of the chromatic aberration of magnification performed henceforth, G pixel serves as a standard which calculates the amount of gaps of the picture element position of R pixel and B pixel, and amendment of the chromatic aberration of magnification is not performed. Therefore, G pixel serves as a picture element position of G pixel after amendment according [the picture element position amended by amendment of the distortion aberration] to amendment of music aberration, and amendment of the chromatic aberration of magnification. On the other hand, amendment of the chromatic aberration of magnification of R pixel and B pixel, Correction formula R_{out} (x, y) and B_{out} (x, y) of the chromatic aberration of magnification which were expressed by the high order polynomial using the coefficient obtained by the lens characteristic data division 47 are obtained, By calculating the correction amount of the chromatic aberration of magnification of R

pixel and B pixel, and adding the position coordinate of the X axial direction of G pixel after amending to this using these correction formulas and the position coordinate of G pixel after the amendment to which amendment of the distortion aberration was performed. The position coordinate of the direction of X after amendment of R pixel to which amendment of a distortion aberration and the chromatic aberration of magnification was performed, and G pixel is acquired. In that case, about a distortion aberration and the chromatic aberration of magnification. As shown in drawing 4 (a) and drawing 5 (a), it is point symmetry around central point O_4 or central point O_5, Since it is furthermore axial symmetry around center line X_4, center line X_5, and center line Y_4 and center line Y_5, Perform correcting operation of each picture element position in field [equivalent to 1/4 of the whole imaging range], for example, field A_4E_4, O_4F_4, or field $A_5E_5O_5F_5$, and a correction amount is obtained, Using the above-mentioned symmetry, the correction amount in other fields is defined, the picture element position after amendment is obtained from this correction amount, and amendment of a distortion aberration and amendment of the chromatic aberration of magnification are performed. When the lens characteristic data division 47 is carrying out the hold stores of the amendment data which calculated beforehand the correction amount in each picture element position, instead of performing this correcting operation and calculating a correction amount, amendment data is used, a correction amount is obtained, and the same compensation process as a described method is performed.

[0059]Thus, in the picture amendment which controls degradation of the image quality resulting from a lens, amendment data volume which lessened the number of times of correcting operation, and was created beforehand can be made less than a storage capacity required in order to hold the amendment data of the whole picture using the symmetry of degradation of the image quality in an imaging range. In the above-mentioned example, also when calculation time is shortened by 1/4 when performing only correcting operation of the field equivalent to 1/4 of the whole imaging range, and using amendment data, the amendment data volume which carries out hold stores also drops to 1/4 compared with the case of all the imaging ranges, and efficient picture amendment can be performed. The above is amendment of the X axial direction of a distortion aberration and the chromatic aberration of magnification, and amendment of Y shaft orientations is similarly performed apart from amendment of an X axial direction.

[0060]In order to perform electronic piece double processing after that, position coordinate x_c and position coordinate y_c of the central point are inputted, R -- a pixel -- G -- a pixel -- and -- B -- a pixel -- an X axial direction -- a position coordinate -- x_{iR} -- ' -- x_{iG} -- ' -- and -- x_{iB} -- ' -- obtaining -- this -- using -- an electron -- a piece -- double -- processing -- giving -- having -- a picture -- amendment -- furthermore -- an electron -- variable power processing -- carrying out -- having had -- image data -- obtaining . Then, color dodge processing and a sharpness process are performed if needed.

[0061]The image data by which the compensation process was carried out in the image processing portion 44B is sent to the data conversion part 44C, and is changed into the image data corresponding to the display by the monitor 20 using 3D(three dimensions)-LUT etc. Then, the amended prescan picture is displayed on the monitor 20.

[0062]An operator performs the check (assay) of a picture, i.e., a processing result, seeing the display of the monitor 20, and adjusts a color/concentration, gradation, etc. using said each key which were set as the keyboard 18a if needed. The input of this adjustment is sent to the conditioning part 48, computes the correction amount of the image processing condition according to an adjustment input, and according to this correction amount, as mentioned above, a compensation process is performed in the LUT-MTX operation part 44A or the image processing portion 44B, and it is again displayed on the monitor 20.

[0063]the picture as which an operator is displayed on the monitor 20 is proper -- a judgment (assay O.K.) will direct the start of this scan using the keyboard 18a etc. By this, an image processing condition is become final and conclusive, and this scanning data of high resolution is sent from the scanner 12, and like prescan image data by the data processing part 38. After amendment, a shading compensation, etc. are performed at the time of A/D (analog to digital) conversion, Log conversion, DC offset amendment, and dark, this scanning data is sent to this scan memory 42.
[0064]Then, this scanned image data read from this scan memory 42, It is sent to this scan picture treating part 46, and like prescan data, by the LUT-MTX operation part 48, color balance adjustment, contrast correction (gradation processing), luminosity amendment, saturation correction, etc. are performed, and it is sent to the image processing portion 46B by the settled image processing condition.By the method same in the image processing portion 46B as the amendment performed by the image processing portion 44B to prescan data. amendment of the distortion aberration which originates under the settled image processing condition at the image formation lens unit 32 of a taking lens or the scanner 12, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, or a picture focus -- a Japanese quince is amended. This scanning data in which amendment was performed is sent to the data conversion part 46C, is changed into the image data which carries out a print output to the printer 16 using 3D(three dimensions)-LUT etc., and is sent to the printer 16.
[0065]The printer 16 exposes photosensitive materials (photographic paper) according to this scanning data, records a latent image, performs the development according to photosensitive materials, and outputs it as a print (result). After cutting photosensitive materials to the specified length according to a print, for example, record of a back print, According to image data (recorded image), modulate three sorts of optical beams, the red (R) exposure according to the spectral sensitivity characteristic of photosensitive materials (photographic paper), green (G) exposure, and the blue (B) exposure G, and. It deviates to a scanning direction and record etc. of the latent image by conveying photosensitive materials to the vertical scanning direction which intersects perpendicularly with a scanning direction are performed, and wet-developing processing of predetermined [, such as the color development, bleach fixing, and rinsing,] is performed, and the photosensitive materials which recorded the latent image are classified and piled up, after drying and considering it as a print. Thus, according to the characteristic of the taking lens of the camera which photoed the lens characteristic and picture of the image formation lens unit 32 which constitutes the characteristic of the optical system 33 of the scanner 12, and the optical system 33 of the scanner 12, the picture which performed picture amendment can obtain as a print.
[0066]As mentioned above, although the image processing device of this invention was explained in detail, in the range which limitation is not carried out to the above-mentioned example, and does not deviate from the gist of this invention, this invention of various kinds of improvement and change being made is natural. in addition -- setting in this invention to the image processing portion 44B of the prescan image processing portion 44, and the image processing portion 46B of this scan picture treating part 46 -- amendment of a distortion aberration, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, and a picture focus, although the Japanese quince is amended, amendment of the distortion aberration in the image processing portion 44B of the prescan image processing portion 44, amendment of the chromatic aberration of magnification, amendment of the amount fall of ambient light, and a picture focus -- a Japanese quince may not be amended but the above-mentioned compensation process may be performed only in the image processing portion 46B of this scan picture treating part 46. Although it was a scanner which reads a picture in photoelectricity using an area CCD sensor in this example, By slit scanning which reads a picture carrying out scanning conveyance of the film F on a career, may be a picture reading **** thing and also in this case degradation of image quality, Since it has the symmetry of the circumference of the center line of the imaging range suitable for a scanning transportation direction, picture amendment can be efficiently performed using this symmetry.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a block diagram of an example using the image processing device of this invention of a digital photo printer.
[Drawing 2]It is a block diagram of an example of the image processing device of the digital photo printer shown in drawing 1.
[Drawing 3]It is an explanatory view showing an example of the picture amendment performed with the image processing device of this invention.
[Drawing 4](a), (b), and (c) are the explanatory views showing other examples of the picture amendment performed with the image processing device of this invention.
[Drawing 5](a), (b), and (c) are the explanatory views showing other examples of the picture amendment performed with the image processing device of this invention.
[Drawing 6](a), (b), and (c) are the explanatory views showing other examples of the picture amendment performed with the image processing device of this invention.
[Drawing 7]It is an explanatory view showing the flow of an example of the picture amendment performed with the image processing device of this invention.
[Description of Notations]
10 Photograph printer
12 Scanner
14 Image processing device
16 Printer
18 Operating system
18a Keyboard
18b Mouse
20 Monitor
22 Light source
24 Variable aperture
26 Colored filter board
28 Diffusion box
32 Image formation lens unit
33 Optical system
34 CCD sensor
36 Amplifier
38 Data processing part
40 Prescan memory
42 This scan memory
44 Prescan image processing portion
46 This scan picture treating part

47 Lens characteristic data division
48 Conditioning part

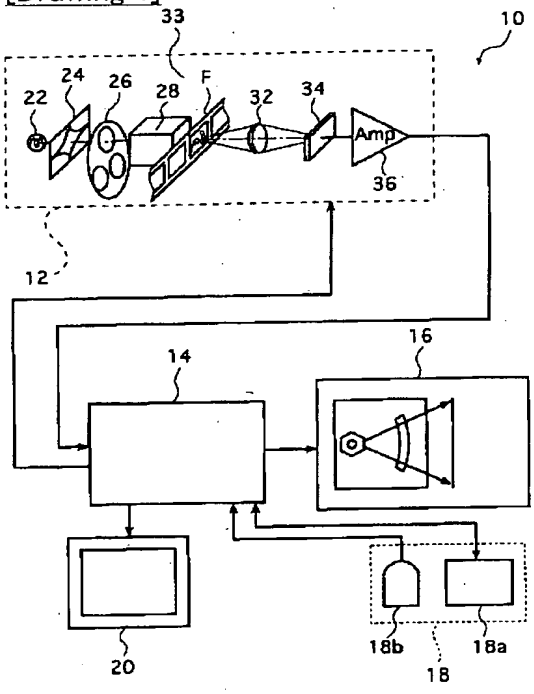
[Translation done.]

* NOTICES *

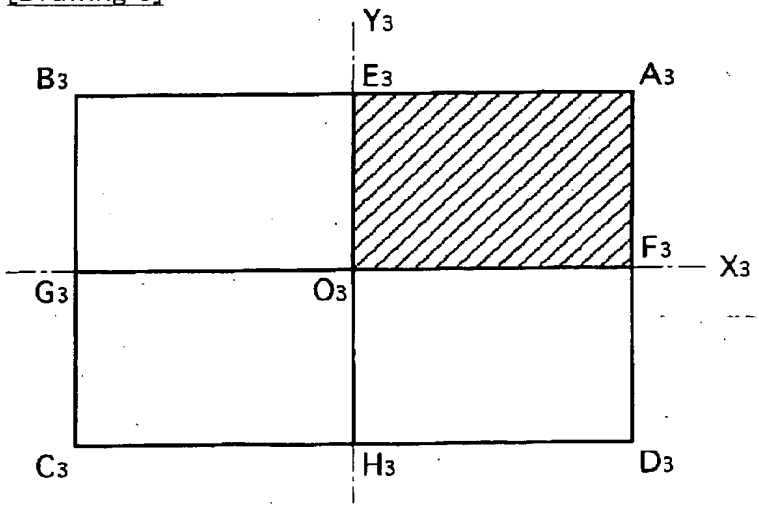
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

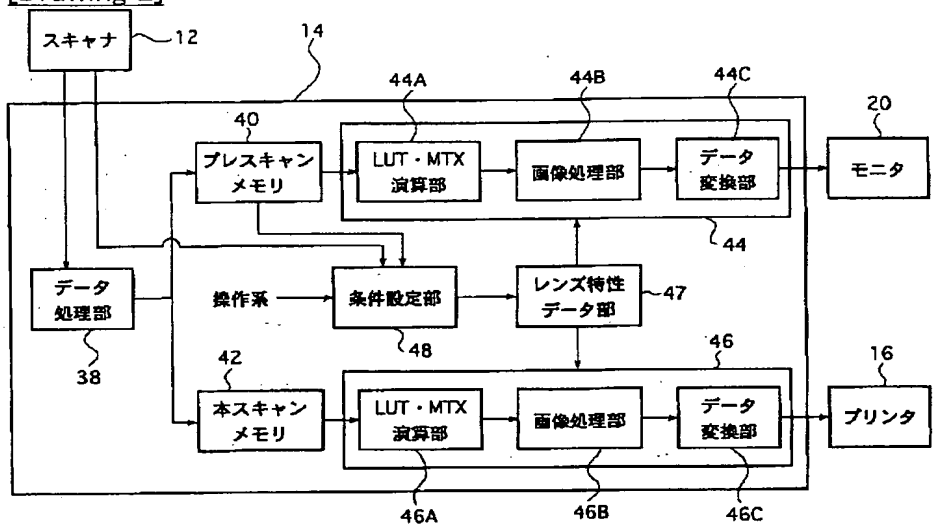
[Drawing 1]



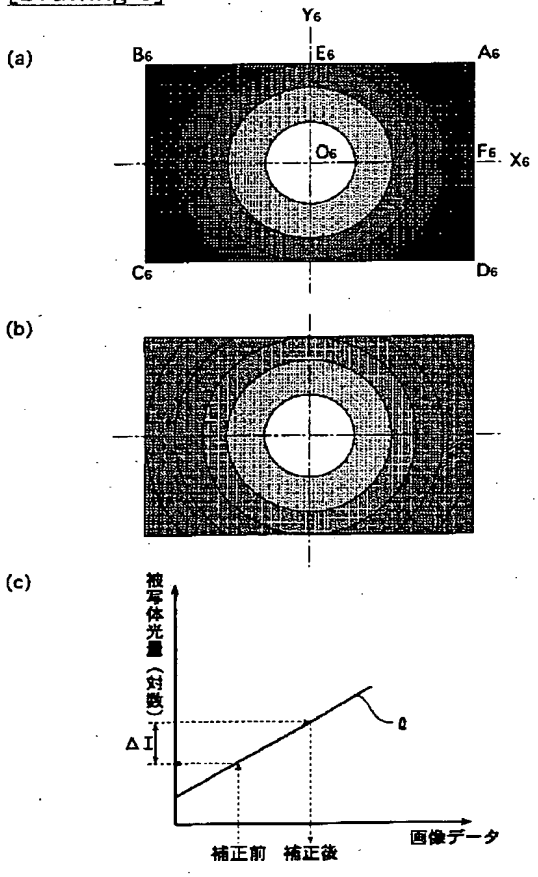
[Drawing 3]



[Drawing 2]

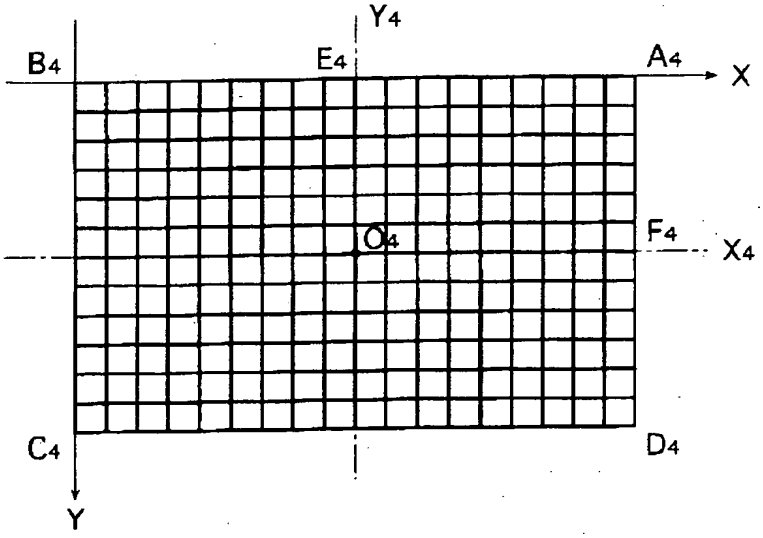


[Drawing 6]



[Drawing 4]

(a)



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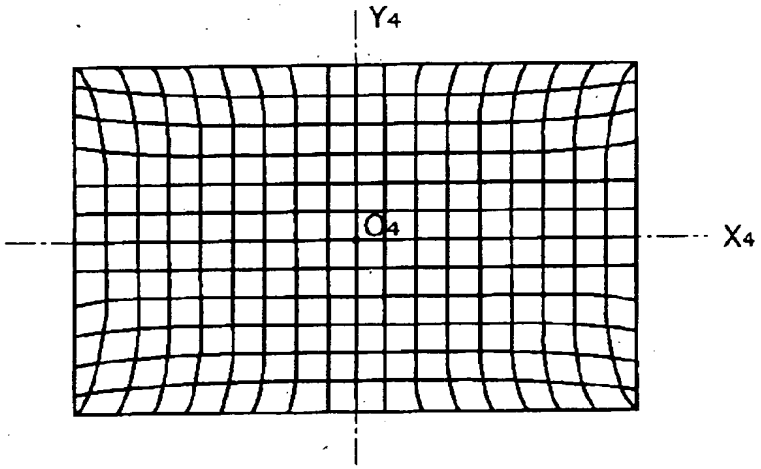
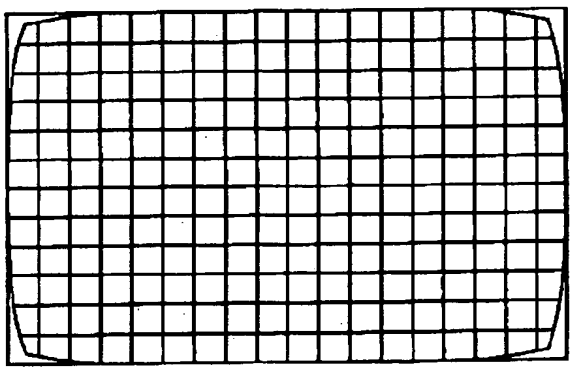
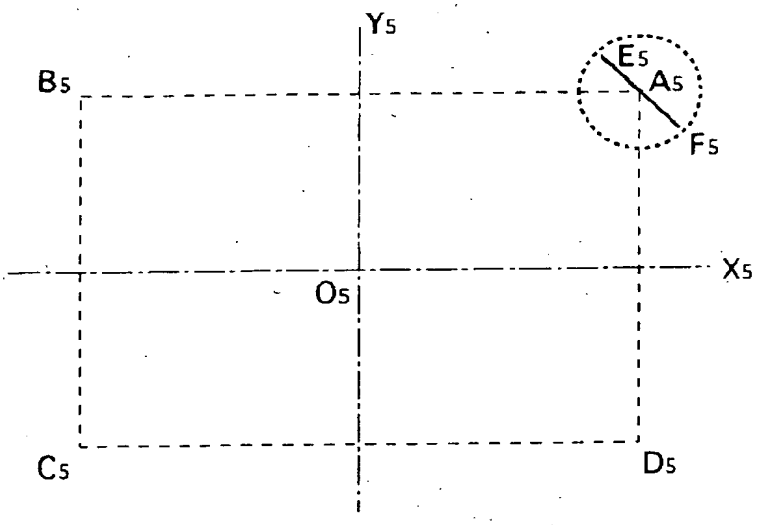


(c)

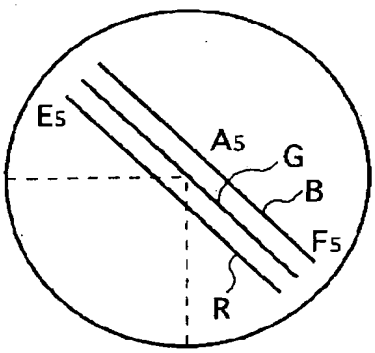


[Drawing 5]

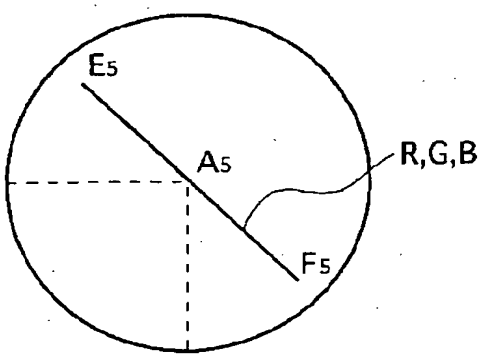
(a)



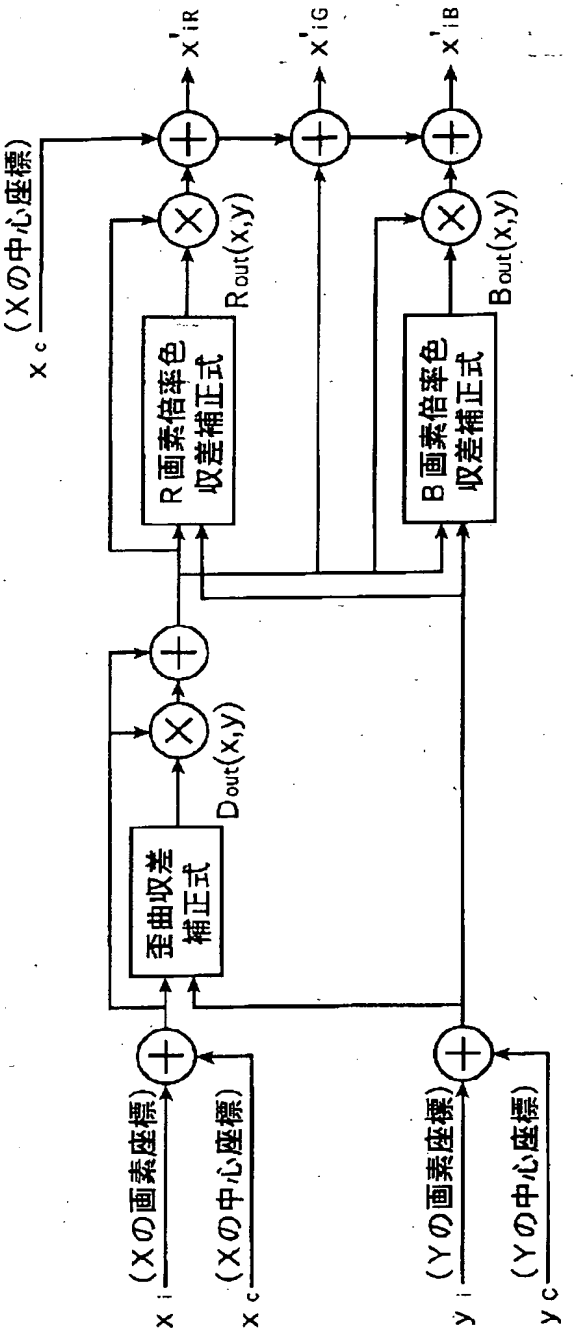
(b)



(c)



[Drawing 7]



[Translation done.]

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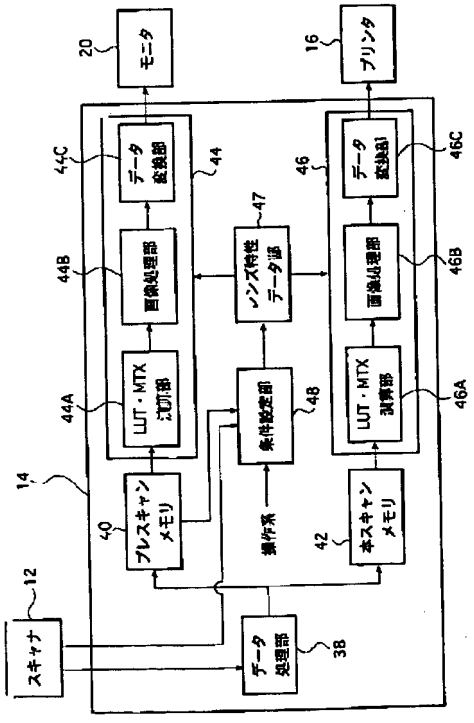
最終頁に続く

(54)【発明の名称】　画像処理装置

(57)【要約】
【課題】画像を撮影した撮影レンズや画像読取装置の結像レンズを含む光学系に起因する画像の画質の劣化を修正する画像補正を施す画像処理装置であって、画像補正処理時間を低減し、また画像補正データ量を低減して、効率よく画像補正を施すことのできる画像処理装置を提供することを課題とする。
【解決手段】画像の画質の劣化を補正する画像補正手段が、画像領域の中心点または中心線に関する画質の劣化の対象性を用いて、前記画像の一部分の補正量から画像全体の補正を行うことを特徴とする画像処理装置を提供することで前記課題を達成する。



【特許請求の範囲】
【請求項１】光学的に形成された画像の画像データに対して補正を施す画像処理装置であって、
画質の劣化を補正する画像補正を画像データに施す補正手段を備え、この補正手段が、画像領域の中心点または中心線に関する画質の劣化の対象性を用いて、前記画像の一部分の補正量から画像全体の補正を行うことを特徴とする画像処理装置。
【請求項２】前記補正手段は、前記画像を撮影した撮影レンズに起因する画質の劣化または前記画像データを得る際の画像読取の光学系に起因する画質の劣化を補正する請求項１に記載の画像処理装置。
【請求項３】前記撮影レンズに起因する画質の劣化を補正する画像補正は、前記撮影レンズに起因する歪曲収差の補正、倍率色収差の補正、周辺光量低下の補正および画像ピントボケの補正のうち少なくとも１つであり、
前記画像読取の光学系に起因する画質の劣化を補正する画像補正は、光学系に起因するシェーディングの補正、前記光学系の結像レンズに起因する歪曲収差の補正、前記結像レンズに起因する倍率色収差の補正、前記結像レンズに起因する周辺光量低下の補正および前記結像レンズに起因する画像ピントボケの補正のうち少なくとも１つである請求項２に記載の画像処理装置。
【請求項４】前記補正手段は、前記画像の一部分の補正量を補正関数から演算して求め、この補正量を用いて画像全体の補正を行う請求項１～３のいずれかに記載の画像処理装置。
【請求項５】前記補正手段は、前記補正関数の画像の中心位置または中心線に対する対象性を考慮して、画像の一部分の補正量を予め演算した補正データを保持し、この補正データを用いて画像全体の補正を行う請求項１～３のいずれかに記載の画像処理装置。
【請求項６】前記補正データを保持するための記憶部の容量が、画像全体の補正データを保持するために必要な記憶容量よりも少ない請求項５に記載の画像処理装置。
【請求項７】前記シェーディング補正は、画像データを光電的に読み取るためにフィルムに撮影された画像を結像させる光学系レンズの絞り値またはズーム倍率から定まる光量ムラの補正量を、光電的に読み取る際の画素毎の読取感度とともに用いて補正を行う請求項３～６のいずれかに記載の画像処理装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、画像を撮影した撮影レンズや画像読取装置の結像レンズを含む光学系に起因する画像の画質の劣化を補正する画像処理装置であって、画像補正処理時間や画像補正データ量を低減して効率よく画像補正を行うことのできる画像処理装置の技術分野に属する。
【０００２】
【従来の技術】現在、ネガフィルム、リバーサルフィルム等の写真フィルム（以下、フィルムとする）に撮影された画像の感光材料（印画紙）への焼き付けは、フィルムの画像を感光材料に投影して感光材料を面露光する、いわゆる直接露光（アナログ露光）によって行われている。
【０００３】これに対し、近年では、デジタル露光を利用する焼付装置、すなわち、フィルムに記録された画像を光電的に読み取って、読み取った画像をデジタル信号とした後、種々の画像処理を施して記録用の画像データとし、この画像データに応じて変調した記録光によって感光材料を走査露光して画像（潜像）を記録し、（仕上り）プリントとするデジタルフォトプリンタが実用化された。
【０００４】デジタルフォトプリンタでは、画像をデジタルの画像データとして、画像データ処理によって焼付時の露光条件を決定することができるので、逆光やストロボ撮影等に起因する画像の飛びやツブレの補正、シャープネス（鮮鋭化）処理、カラーフェリアや濃度フェリアの補正、アンダー露光やオーバー露光の補正、周辺光量低下の補正等を好適に行って、従来の直接露光では得られなかった高品位なプリントを得ることができる。しかも、複数画像の合成や画像分割、さらには文字の合成等も画像データ処理によって行うことができ、用途に応じて自由に編集／処理したプリントも出力可能である。しかも、デジタルフォトプリンタによれば、デジタルカメラ等で撮影された画像（画像データ）からプリントを作成することもでき、さらに、画像をプリント（写真）として出力するのみならず、画像データをコンピュータ等に供給したり、フロッピー（登録商標）ディスク等の記録媒体に保存しておくこともできるので、画像データを、写真以外の様々な用途に利用することができる。
【０００５】このようなデジタルフォトプリンタは、基本的に、フィルムに記録された画像を光電的に読み取るスキャナ（画像読取装置）、読み取った画像を画像処理して記録用の画像データとする画像処理装置、および、この画像データに応じて感光材料を走査露光して現像処理を施してプリントとするプリンタ（画像記録装置）より構成される。
【０００６】スキャナでは、光源から射出された読取光をフィルムに入射して、フィルムに撮影された画像を担持する投影光を得て、この投影光を光学系結像レンズによってＣＣＤセンサ等のイメージセンサに結像して光電変換することにより画像を読み取り、必要に応じて各種の画像処理を施した後に、フィルムの画像データ（画像データ信号）として画像処理装置に送る。画像処理装置は、スキャナによって読み取られた画像データから画像処理条件を設定して、設定した条件に応じた画像処理を画像データに施し、画像記録のための出力画像データ（露光条件）としてプリンタに送る。プリンタでは、例

えば、光ビーム走査露光を利用する装置であれば、画像処理装置から送られた画像データに応じて光ビームを変調して、感光材料を二次元的に走査露光（焼付け）して潜像を形成し、次いで、所定の現像処理等を施して、フィルムに撮影された画像が再生されたプリント（写真）とする。

【０００７】ところで、プリントに再生された画像の画質の劣化の原因として、画像を撮影したカメラの撮影レンズに起因する倍率色収差、歪曲収差、周辺光量低下、画像ピントボケ等や、光電的に読み取る画像読取装置の結像レンズに起因する倍率色収差、歪曲収差、周辺光量低下、画像ピントボケや画像読取装置の結像レンズを含む光学系に起因するシェーディングが挙げられる。

【０００８】カラー画像は、赤（Ｒ）、緑（Ｇ）および青（Ｂ）の３原色によって形成されるが、レンズの屈折率（結像倍率）は波長によって微妙に異なるため、Ｒ、ＧおよびＢの光の結像倍率が異り、すなわち倍率色収差が生じ、得られた画像に色ずれが生じてしまう。また、適正な撮影画像を得るためには、シーン中の光軸に垂直な平面は、光軸に対して垂直な同一平面上に結像される必要がある。ところが、通常のレンズでは、結像面が光軸方向にずれる、いわゆる歪曲収差を生じて結像画像が歪み（ディストーションを生じ）、得られた画像が歪みを有するものとなってしまう。さらに、撮影レンズや結像レンズの性能に応じて生じる、中心部よりも周辺部の方が画像が暗くなってしまう周辺光量の低下や、ピント位置がフィルムの面方向で異なることに起因する画像ピントボケ等も、画質の劣化の原因となっている。さらに、光学系の光源の光量不均一や結像レンズの性能、さらには光学系全体の性能によって、光源から射出された読取光自体に光強度のムラが生じ、画像に照射される光量にもムラができ、その結果濃度ムラを生じさせるシェーディングも、画質の劣化の原因となっている。

【０００９】一眼レフ等のように、ある程度のコストを掛けられるカメラであれば、精度の高い撮影レンズを用い、さらに複数枚のレンズを組み合わせることにより、撮影レンズに起因する画像の画質劣化を抑制することができる。また、画像読取装置がある程度コストを掛けられるものであれば、精度の高い結像レンズを用い、さらに複数枚のレンズを組み合わせることにより、また精密な光学系を用いることにより、結像レンズを含む光学系に起因する画像の劣化を抑制することができる。しかしながら、レンズ付きフィルムや安価なコンパクトカメラでは、レンズにコストを掛けることができず、また簡易かつ小型の画像読取装置では、結像レンズや光学系等にコストをそれほど掛けることができないため、画像に倍率色収差、歪曲収差、周辺光量の低下、画像ピントボケやシェーディングが生じてしまう。その結果、プリントとして再生された画像は、画質の劣化した画像となってしまう問題が生じる。

【００１０】このような問題に対して、特開平９－２８１６１３号公報に挙げられるように、撮影レンズに関する情報等を取得し、取得情報に基づいて画質の劣化を判断し、判断された劣化状態に基づいて画像の画質の劣化を補正する写真処理装置を提案している。上記写真処理装置では、取得した撮影レンズに関する情報等に基づいて画像の画質の劣化状態を判断し、判断に応じて画像全体の補正量を求め画像全体の補正を行って、撮影レンズに起因する画像の倍率色収差、歪曲収差、周辺光量の低下および画像ピントボケを補正することができる。

【００１１】

【発明が解決しようとする課題】ところで、上記写真処理装置では、撮影レンズに起因する画像の倍率色収差、歪曲収差、周辺光量の低下および画像ピントボケを補正する際、画像全体にわたって補正量を求めることで画像全体の補正を行っているため、補正量を各画素毎に求める必要がある。画像の大きさによっては、例えば２０００画素×１０００画素の画像データのような大きな画像データに対しても各画素毎に補正量を求めなければならない。そのため、画素毎に補正量を演算して求める処理時間が増大してしまうといった問題が生じた。また、画像データに補正を施すための補正量を各画素毎に予め求めた補正データを画像の画素毎に記憶保持することも考えられるが、補正データのために必要な記憶容量も大きな画像データに応じて大きくなり、補正データの読み出し時間もかかり、効率のよい画像補正を行うことはできず、簡易かつ小型の画像読取装置を実現することはできないという問題が生じた。

【００１２】また、上記写真処理装置では、撮影レンズに関する情報等に基づいて画像の画質の劣化状態を判断し、判断に応じて画像の補正を行っているにすぎず、簡易な画像読取装置の結像レンズや光学系に起因する画質の劣化を抑制することはできない。

【００１３】そこで、本発明は、上記問題点を解決するために、光学的に撮影された画像の画像データを入力用の画像データとして画像補正を施し、出力用の画像データを得る画像処理装置において、画像を撮影した撮影レンズや画像読取装置の結像レンズを含む光学系に起因する画像の画質の劣化を修正する画像補正を施す際に、画像補正処理時間を低減し、また画像補正データ量を低減して、効率よく画像補正を施すことのできる画像処理装置を提供することを目的とする。

【００１４】

【課題を解決するための手段】上記目的を達成するために、本発明は、光学的に形成された画像の画像データに対して補正を施す画像処理装置であって、画質の劣化を補正する画像補正を画像データに施す補正手段を備え、この補正手段が、画像領域の中心点または中心線に関する画質の劣化の対象性を用いて、前記画像の一部分の補正量から画像全体の補正を行うことを特徴とする画像処

理装置を提供するものである。

【００１５】その際、前記補正手段は、前記画像を撮影した撮影レンズに起因する画質の劣化または前記画像データを得る際の画像読取の光学系に起因する画質の劣化を補正するのが好ましく、また、前記撮影レンズに起因する画質の劣化を補正する画像補正は、前記撮影レンズに起因する歪曲収差の補正、倍率色収差の補正、周辺光量低下の補正および画像ピントボケの補正のうち少なくとも１つであり、前記画像読取の光学系に起因する画質の劣化を補正する画像補正は、光学系に起因するシェーディングの補正、前記光学系の結像レンズに起因する歪曲収差の補正、前記結像レンズに起因する倍率色収差の補正、前記結像レンズに起因する周辺光量低下の補正および前記結像レンズに起因する画像ピントボケの補正のうち少なくとも１つであるのが好ましい。

【００１６】また、前記補正手段は、前記画像の一部分の補正量を補正関数から演算して求め、この補正量を用いて画像全体の補正を行うのが好ましく、また、前記補正手段は、前記補正関数の画像の中心位置または中心線に対する対象性を考慮して、画像の一部分の補正量を予め演算した補正データを保持し、この補正データを用いて画像全体の補正を行ってもよい。その際、前記補正データを保持するための記憶部の容量が、画像全体の補正データを保持するために必要な記憶容量よりも少ないのが好ましい。また、前記シェーディング補正は、画像データを光電的に読み取るためにフィルムに撮影された画像を結像させる光学系レンズの絞り値またはズーム倍率から定まる光量ムラの補正量を、光電的に読み取る際の画素毎の読取感度とともに用いて補正を行うのが好ましい。

【００１７】

【発明の実施の形態】以下、本発明の画像処理装置について、添付の図面に示される好適実施例を基に詳細に説明する。

【００１８】図１に、本発明の画像処理装置を備えるデジタルフォトプリンタ１０の一例のブロック図を示す。図１に示されるデジタルフォトプリンタ（以下、フォトプリンタ１０とする）は、基本的に、フィルムＦに撮影された画像を光電的に読み取るスキャナ（画像読取装置）１２と、読み取られた画像データの画像処理やフォトプリンタ１０全体の操作および制御等を行う画像処理装置１４と、画像処理装置１４から出力された画像データに応じて変調した光ビームで感光材料（印画紙）を画像露光し、現像処理して（仕上り）プリントとして出力するプリンタ１６とを有して構成される。また、画像処理装置１４には、様々な条件の入力（設定）、処理の選択や指示、色／濃度補正などの指示等を入力するためのキーボード１８ａおよびマウス１８ｂを有する操作系１８と、スキャナ１２で読み取られた画像、各種の操作指示、様々な条件の設定／登録画面等を表示するモニタ２０が接続される。

【００１９】スキャナ１２は、フィルムＦ等に撮影された画像を１コマずつ光電的に読み取る装置で、光源２２と、可変絞り２４と、画像をＲ（赤）、Ｇ（緑）およびＢ（青）の三原色に分解するためのＲ、ＧおよびＢの３枚の色フィルタを有し、回転して任意の色フィルタを光路に作用する色フィルタ板２６と、フィルムＦに入射する読取光をフィルムＦの面方向で均一にする拡散ボックス２８と、結像レンズユニット３２と、フィルムの１コマの画像を読み取るエリアセンサであるＣＣＤセンサ３４と、アンプ（増幅器）３６とを有して構成され、光源２２、可変絞り２４、色フィルタ板２６、拡散ボックス２８および、結像レンズユニット３２は、光学系３３を形成する。

【００２０】なお、図示例のフォトプリンタ１０においては、新写真システム(Advanced Photo System)や１３５サイズのネガ（あるいはリバーサル）フィルム等のフィルムの種類やサイズ、ストリップスやスライド等のフィルムの形態、トリミング等の処理の種類等に応じて、スキャナ１２の本体に装着自在な専用のキャリアが用意されており、キャリアを交換することにより、各種のフィルムや処理に対応することができる。フィルムに撮影され、プリント作成に供される画像（コマ）は、このキャリアによって所定の読取位置に搬送、保持される。また、周知のように、新写真システムのフィルムには、磁気記録媒体が形成され、カートリッジＩＤやフィルム種等が記録されており、また、撮影時や現像時等に、撮影日時、撮影に使用したカメラ、現像機の種類等の各種のデータが記録可能である。新写真システムのフィルム（カートリッジ）に対応するキャリアには、この磁気情報の読取手段が配置されており、フィルムを読取位置に搬送する際に磁気情報を読み取り、前記各種の情報が画像処理装置１４に送られる。

【００２１】このようなスキャナ１２においては、光源２２から射出され、可変絞り２４によって光量調整され、色フィルタ板２６を通過して色調整され、拡散ボックス２８で拡散された読取光が、キャリアによって所定の読取位置に保持されたフィルムＦの１コマに入射して、透過することにより、フィルムＦに撮影されたこのコマの画像を担持する投影光を得る。フィルムＦの投影光は、結像レンズユニット３２によってＣＣＤセンサ３４の受光面に結像され、ＣＣＤセンサ３４によって光電的に読み取られ、その出力信号がアンプ３６で増幅されて、画像処理装置１４に送られる。ＣＣＤセンサ３４は、例えば、１３８０×９２０画素のエリアＣＣＤセンサである。

【００２２】スキャナ１２においては、このような画像読取を、色フィルタ板２６の各色フィルタを順次挿入して３回行うことにより、１コマの画像をＲ，ＧおよびＢの３原色に分解して読み取る。ここで、フォトプリンタ

１０においては、プリントを出力するための画像読み取り（本スキャン）に先立ち、画像処理条件等を決定するために、画像を低解像度で読み取るプレスキャンを行う。従って、１コマで、合計６回の画像読み取りが行われる。

【００２３】スキャナ１２は、エリアＣＣＤセンサを用い、色フィルタ板２６によって投影光を３原色に分解して画像を読み取っているが、本発明に利用されるスキャナとしては、３原色のそれぞれの読み取りに対応する３種のラインＣＣＤセンサを用い、フィルムＦをキャリアで走査搬送しつつ画像を読み取るスリット走査によって画像読み取りを行うものであってもよい。

【００２４】図示例のフォトプリンタ１０は、ネガやリバーサル等のフィルムに撮影された画像を光電的に読み取るスキャナ１２を画像処理装置１４の画像データ供給源としているが、画像処理装置１４に画像データを供給する画像データ供給源としては、スキャナ１２以外にも、反射原稿の画像を読み取る画像読取装置、デジタルカメラやデジタルビデオカメラ等の撮像デバイス、ＬＡＮ(Local Area Network)やコンピュータ通信ネットワーク等の通信手段、メモリカードやＭＯ（光磁気記録媒体）等のメディア（記録媒体）等の、各種の画像読取手段や撮像手段、画像データの記憶手段等が各種使用可能である。本発明においては、これらの手段から得られる画像は、少なくとも光学的に撮影されたものであればよい。

【００２５】スキャナ１２からの出力信号（画像データ）は、画像処理装置１４に出力される。図２に画像処理装置（以下、処理装置１４とする）のブロック図を示す。処理装置１４は、データ処理部３８、プレスキャン（フレーム）メモリ４０、本スキャン（フレーム）メモリ４２、プレスキャン画像処理部４４、本スキャン画像処理部４６、および条件設定部４８を有して構成される。なお、図２は、主に画像処理関連の部位を示すものであり、処理装置１４には、これ以外にも、処理装置１４を含むフォトプリンタ１０全体の制御や管理を行うＣＰＵ、フォトプリンタ１０の作動等に必要な情報を記憶するメモリ、本スキャンの際の可変絞り２４の絞り値（結像レンズユニット３２の絞り値）やＣＣＤセンサ３４の蓄積時間を決定する手段等が配置され、また、操作系１８やモニタ２０は、このＣＰＵ等（ＣＰＵバス）を介して各部位に接続される。

【００２６】データ処理部３８は、スキャナ１２から出力されたＲ，ＧおよびＢの各出力信号は、Ａ／Ｄ（アナログ／デジタル）変換、Ｌｏｇ変換、ＤＣオフセット補正、暗時補正、シェーディング補正等を行う部分である。フォトプリンタ１０では、例えば拡散ボックス２８や結像レンズユニット３２等にコストを掛けて精密な光学系３３を形成させることが困難な場合、シェーディング、すなわち照射光の光強度のムラが発生し易い。たとえば、画像中心付近では光の強度が強く、周辺では光の強度が弱い。このような光の強弱は、拡散ボックス２８や結像レンズユニット３２のみならず、スキャナ１２の光学系３３、すなわち光源２２や可変絞り２４や色フィルタ板２６等を含めた光学系３３全体に起因して発生する。そのため、このようなフォトプリンタ１０では、画像の明度を光量の補正量から調整することで、ほぼ均一な光量による画像を得ることができるようにシェーディング補正を適格に行う必要がある。また、シェーディングは、結像レンズユニット３２の絞り値またはズーム倍率によって変化するため、絞り値やズーム倍率に応じてシェーディング補正の補正量も変化するように構成される。

【００２７】このようなシェーディング補正の補正量は光量の補正量として定められ、絞り値やズーム倍率に応じた補正量を絞り値やズーム倍率に応じて定まる補正関数、例えば２次や３次の高次多項式から画素位置毎に求める。その際、図３に示すように、シェーディングは、図３に示す画像領域の中心線X_3 および中心線Y_3 の回りにほぼ線対称、また中心点O_3 の回りにほぼ点対称の特徴を備えるため、この対称性を用い、画像全体の領域A_3 B_3 C_3 D_3 の４分の１の領域A_3 E_3 O_3 F_3 を画素毎に補正演算を行い補正量を求め、また領域A_3 E_3 O_3 F_3 の補正量から成る補正データを予め作成し図示されない記憶部に記憶保持し、必要に応じて補正データを呼出して補正量を得、この補正量を用いて、他の領域、例えば領域A_3 E_3 O_3 F_3 と中心線Y_3 と線対称になる領域E_3 B_3 G_3 O_3 を画像補正することによって、画像全体の画像補正を行うことができる。このように補正すべきシェーディングの対称性を利用して、補正演算の回数を少なくし、また、補正データ量を、画像全体の補正データを保持するために必要な記憶容量よりも少なくすることができ、効率のよいシェーディング補正を行うことができる。

【００２８】また、予め画素毎に絞り値やズーム倍率に応じた補正量を補正データとして記憶部に記憶保持させ、必要に応じてこの補正データを呼び出して補正量を得てもよい。なお、シェーディング補正のための補正量は、光量に関する補正量であるため、スキャナ１２で光電的に画像を読み取る際のＣＣＤセンサ３４を構成するＣＣＤ素子の感度ムラを考慮して、予め画素ごとに読取感度を記憶保持したデータを呼び出して、ＣＣＤ素子の感度に応じて画像データの補正を行う。

【００２９】データ処理部３８では、プレスキャンによる画像信号と、本スキャンによる画像信号が、処理されてそれぞれ、プレスキャンデータおよび本スキャンデータとされ、プレスキャンデータはプレスキャンメモリ４０に、本スキャンデータは本スキャンメモリ４２にそれぞれ記憶（格納）される。なお、プレスキャンデータと本スキャンデータは、解像度（画素密度）と信号レベル

が異なる以外は、基本的に同じデータである。

【００３０】プレスキャンメモリ４０に記憶されたプレスキャンデータはプレスキャン画像処理部４４において、本スキャンメモリ４２に記憶された本スキャンデータは本スキャン画像処理部４６において、それぞれ処理される。プレスキャン画像処理部４４は、ＬＵＴ・ＭＴＸ演算部４４Ａ、画像処理部４４Ｂおよびデータ変換部４４Ｃを有して構成される。他方、本スキャン画像処理部４６は、ＬＵＴ・ＭＴＸ演算部４６Ａ，画像処理部４６Ｂおよびデータ変換部４６Ｃを有して構成される。

【００３１】ＬＵＴ・ＭＴＸ演算部４４ＡとＬＵＴ・ＭＴＸ演算部４６Ａは、共に、後述する条件設定部４８が設定した画像処理条件に応じて、スキャナ１２によって読み取られた画像（画像データ）に色バランス調整、コントラスト補正（階調処理）、明るさ補正、彩度補正等を施す部分である。これらの処理は、ＬＵＴ（ルックアップテーブル）による処理、マトリクス（ＭＴＸ）演算等公知の方法で行われるものであり、色バランス調整、明るさ補正およびコントラスト補正がＬＵＴで行われ、彩度補正がＭＴＸ演算で行われる。

【００３２】画像処理部４４Ｂと画像処理部４６Ｂは、スキャナ１２で読み込まれた画像の撮影レンズやスキャナ１２の結像レンズユニット３２に起因するレンズの収差の補正や周辺光量低下の補正や画像ピントボケの補正を行う部分である。ここで、撮影レンズを判別するには、例えば、フィルムＦが新写真システムのレンズ付きフィルムである場合には、フィルムＦに記録された磁気情報をスキャナ１２のキャリアに設けられる図示されない磁気ヘッド等で読み取り、磁気記録されたカートリッジＩＤやフィルム種等を利用してレンズ付きフィルムの機種すなわちカメラを判別することができ、また、フィルムに光学的に記録されている拡張ＤＸコードの「ＳＳＵ　ＩＮＤＩＣＡＴＯＲ」をキャリアで光学的に読み取り、これを利用することができる。また、新写真システムに対応するカメラには、フィルムＦにカメラの機種を磁気記録する機能を有する機種もあるので、これを利用してフィルムＦを撮影したカメラを判別してもよい。また、受け付け時に、レンズ付きフィルムの機種や、あるいは撮影カメラの機種を顧客から聞いて、メモ、パッケージ、パトローネ、カートリッジ等に記録しておき、プリント作成時にオペレータがこれを見てキーボード１８ａでカメラの機種を入力してもよく、カメラの機種に代えてファンクションキー等とカメラとの対応を決定しておき、これを用いて入力してもよい。さらに、撮影時にフィルムにカメラの機種を光学的に焼き付け、これを読み取ってカメラの機種を判別してもよい。レンズ付きフィルムであれば、製造時等にレンズ付きフィルムの機種をＤＸコード等のように光学的に焼付けておき、あるいは磁気記録しておき、これらを用いて機種を判別してもよい。また、ＩＣメモリ付きのフィルムカートリッジであれば、このＩＣメモリにカメラの機種等を電気的に記録しておき、これを用いて機種を判別してもよい。

【００３３】判別されたカメラの機種等の情報を用いて後述するレンズ特性データ部４７から撮影レンズに起因する画質の劣化の補正、すなわち収差の補正や周辺光量低下の補正や画像ピントボケの補正に用いる補正式の係数を呼び出し、この係数から補正式を得ることができる。また、補正量を予め求めて作成した補正データを呼び出してもよい。スキャナ１２に用いられる結像レンズユニット３２のレンズ特性は予め判っているので、画像補正を行うための補正演算に用いる補正式の係数を予めレンズ特性データ部４７に記憶し、画像処理部４４Ｂや画像処理部４６Ｂで画像補正を行う度にこの補正式の係数を呼び出すことができる。また、補正量を予め求めて作成した補正データを呼び出してもよい。

【００３４】ここで、撮影レンズや結像レンズユニット３２に起因する収差の補正には、歪曲収差の補正と倍率色収差の補正があるが、歪曲収差の補正および倍率色収差の補正は、撮影レンズや結像レンズユニット３２のレンズ特性から係数と共に得られれた補正式と、画像データ（画素）の位置の情報、例えば、画像の中心（撮影レンズの光軸の中心）からの座標位置（中心の画素から何画素目か）とを用いて、各画素位置の移動補正量を求めるものである。また、予めこの補正量を作成した補正データ呼び出して画像データを補正してもよい。

【００３５】歪曲収差とは、図４（ａ）に示されるフィルム上に撮影された格子状パタンの画像が撮影レンズやスキャナ１２の結像レンズユニット３２の特性によって図４（ｂ）に示されるように画像自体が糸巻型等に歪む状態をいい、歪曲収差の補正とは、この歪んだ画像に対して、補正量を算出する補正式を用いて、あるいは予め補正量を画素毎に作成した補正データを用いて、図４（ｃ）のように画像を格子状パタンに戻すための補正である。

【００３６】図４（ａ）に示すように画像の中心点を中心点O_4とすると、図４（ｂ）に示すように、歪曲収差は中心点O_4の回りに点対称であり、また、画像の中心線を中心線X_4および中心線Y_4とすると、この中心線X_4および中心線Y_4の回りに線対称である。そのため、歪曲収差を補正するための補正量も中心点O_4の回りに点対称であり、中心線X_4および中心線Y_4の回りに線対称である。そこで、画像領域A_4 B_4 C_4 D_4を中心線X_4および中心線Y_4で区切った４分の１の領域、例えば領域A_4 E_4 O_4 F_4の補正量のみを得、線対称や点対称を利用することによって、ほかの領域の補正量を定めることができる。本実施例では、画像領域の４分の１の領域について補正量を得るものであるが、これに限定されず、画像領域の２分の１の領域等、画像領域の一部分の領域について補正量を得るものであればよい。

【００３７】倍率色収差とは、図５（ａ）に示されるように、フィルムＦ上に撮影された画像が仮想の矩形A_5 B_5 C_5 D_5 の点A_5 上を通る直線E_5 F_5 の画像である場合、図５（ｂ）に示されるように、直線E_5 F_5 のＲ画素、Ｇ画素およびＢ画素の位置がずれて色ズレを起こす状態をいい、倍率色収差の補正とは、この色ズレした画像に対して、各画素位置毎に補正式を用いて補正量を得、この補正量から図５（ｃ）のようにＲ画素、Ｇ画素およびＢ画素の画素位置を修正するものである。例えば、Ｇ画素の位置を基準として、直線E_5 F_5 のＲ画素およびＢ画素の位置を修正するための補正である。歪曲収差の補正と同様に、予め補正量を画素毎に作成した補正データを保持記憶し、必要に応じてこれを呼び出して補正量を得てもよい。

【００３８】このような倍率色収差は図５（ａ）に示される中心点O_5 の回りに点対象であり、また中心線X_5 や中心線Y_5 の回りに線対称であるため、倍率色収差の補正のためのＲ画素の補正量やＢ画素の補正量も、上記歪曲収差の補正のための補正量と同様に、画像領域全体を中心線X_5 および中心線Y_5 で区切った４分の１の領域、例えば領域A_5 E_5 O_5 F_5 の補正量のみを補正演算して求め、これを用いてほかの領域のＲ画素の補正量やＢ画素の補正量を、線対称や点対称を用いて定めることができる。本実施例では、上記歪曲収差の補正と同様に、画像領域の４分の１の領域について補正演算を行い補正量を求めるものであるが、これに限定されず、画像領域の一部分の領域について補正演算を行うものであればいずれであってもよい。なお、歪曲収差および倍率色収差における補正量は、画像領域の一部分の領域、例えば図４（ａ）に示されるような領域、例えば領域A_4 E_4 O_4 F_4 のような画像領域の４分の１の領域の補正量を予め補正演算を行って求めた補正データを記憶保持し、必要に応じてこの補正データを呼出し補正を行ってもよい。

【００３９】この歪曲収差の補正と倍率色収差の補正の補正は、さらに電子変倍処理とともに一括して処理される。すなわち、歪曲収差に起因するＧ画素の位置のずれ量を求め、Ｇ画素の補正後の位置から、Ｒ画素およびＢ画素毎に適正位置を算出し、Ｇ画素に対するＲ画素およびＢ画素の位置のずれ量を求め、算出された各画素の適正位置の情報を用いて、画像データを補間して画像の電子変倍処理を行う。言い換えれば、倍率色収差および歪曲収差による画素位置のずれ量を算出することにより、各画素が本来どの位置にあるべきであるかを知見し、この適正な位置に応じて画像データの補間演算を行って電子変倍処理を行う。電子変倍処理の方法には特に限定はなく、公知の方法が各種利用可能であり、例えば、バイリニア補間を用いる方法、スプライン補間を用いる方法等が例示される。これにより、１回の補間演算で、倍率色収差および歪曲収差の補正と、電子変倍処理を行うことができる。

【００４０】上記歪曲収差の補正や倍率色収差の補正は、撮影レンズや結像レンズユニット３２の補正式、たとえば高次多項式と、画像データ（画素）の位置の情報、例えば、画像の中心（撮影レンズの光軸の中心）からの座標位置（中心の画素から何画素目か）とを用いて、倍率色収差および歪曲収差の補正、ならびに電子変倍処理を行うが、この場合各画素の位置座標は、ｘ－ｙ座標でも極座標でもよい。また、画素位置の情報は画像の中心点を基準とするのに限定はされず、各種のものが利用可能であり、例えば、画像の角部（左上角等）や、ある画素（例えば画素番号１番の画素）等を基準としてもよく、さらに画像の外部、例えばフィルムＦのパーフォレーション等を基準としてもよい。すなわち、画像（画素）の位置が相対的に検出できれば、各種の位置情報が利用可能である。なお、マスク等によって切り出された画像の中心が、ほぼ撮影時のレンズの光軸の中心と考えられる場合には、切り出された画像の中心の画素をレンズの光軸の中心として、各種の収差（歪曲収差、倍率色収差、周辺光量低下、画像ピントボケ）を補正してもよい。

【００４１】また、画像処理部４４Ｂおよび画像処理部４６Ｂは、撮影レンズや結像レンズユニット３２に起因して生じる画像ピントボケや周辺光量低下の補正も行うことができる。例えば、周辺光量低下の補正の対象となる周辺光量低下とは、図６（ａ）に示すように、撮影レンズや結像レンズユニット３２に起因して光量のムラが生じ、画像領域A_6 B_6 C_6 D_6 の明度値が、画像領域の中心点O_6 から離れるにつれて、cosine４乗則に従って低下する状態をいい、周辺光量低下の補正とは、周辺光量低下を解消するように、画像の周辺領域に位置する画素ほど、画像データの値（明度値）を上昇させるように、撮影レンズや結像レンズユニット３２の特性によって定まる補正式を用いて各画素位置毎の補正量を得て行う補正をいう。また、予め補正演算を行って求めた補正データを記憶保持し、必要に応じてこの補正データを呼出し補正量を得てもよい。

【００４２】周辺光量の低下については、図６（ａ）に示されるように、画像の中心点O_6のまわりに点対象の特徴を有しているので、中心線X_6 や中心線Y_6 で区切られた画像領域A_6 B_6 C_6 D_6 の一部分、例えば領域A_6 E_6 O_6 F_6 の補正量のみを補正式から補正演算して補正量を求め、これを用いてほかの領域の補正量を線対称や点対称を考慮して定め、周辺光量の低下をほぼ解消した図６（ｂ）のような明度分布の画像を得ることができる。図６（ｃ）は、周辺光量低下の補正方法について示しており、変換直線Ｉの勾配を各画素毎に定め、光量の補正量ΔＩから画像データの補正を行う。すなわち、周辺光量低下の補正前の画像データを、ＣＣＤセンサ３４のＣＣＤ素子の感度を用いて、被写体光量に変換

し、撮影レンズや結像レンズユニット３２によって定まる補正式から補正量ΔＩを求め光量の補正を行う。補正された被写体光量は、画像データに変換されて、補正後の画像データを得る。この場合、画素毎にＣＣＤセンサ３４のＣＣＤ素子の感度（光量に対する画像データの信号値の感度）が異なるので、図６（ｃ）に示される変換直線１の勾配を画素ごとに予め記憶保持し、必要に応じて呼び出して感度ムラを補正することができる。また、歪曲収差の補正や倍率色収差の補正の場合と同様に、画像領域A_6 B_6 C_6 D_6 の一部分の領域、例えば領域A_6 E_6 O_6 F_6 のような画像領域の４分の１の領域の補正量を予め補正演算を行って作成した補正データを記憶保持し、必要に応じてこの補正データを呼出し補正を行ってもよい。

【００４３】なお、画像処理部４４Ｂや４６Ｂでは、データ処理部３８でのシェーディング補正が結像レンズユニット３２に起因する周辺光量低下の補正を含む場合、同じ周辺光量低下の補正が重ならないように、画像処理部４４Ｂや４６Ｂでの周辺光量低下の補正を行わない。

【００４４】画像処理部４４Ｂおよび画像処理部４６Ｂは、画像を撮影したカメラの撮影レンズやスキャナ１２の結像レンズユニット３２に起因する画像補正を行うが、本発明の画像処理装置では、撮影レンズに起因して画質の劣化した画像の補正や結像レンズユニット３２に起因して画質の劣化した画像の補正の場合に限られず、撮影レンズおよび結像レンズユニット３２の双方に起因して画質の劣化した画像を補正するものであってもよい。この場合、撮影レンズに関する補正式と結像レンズユニット３２に関する補正式を加算してまとめて補正することができる。

【００４５】このように撮影レンズや結像レンズ等のレンズに起因する画質の劣化を抑制する画像補正では、画像領域での画質の劣化の対称性を利用して、補正演算の回数を少なくし、また、予め作成した補正データ量を、画像全体の補正データを保持するために必要な記憶容量よりも少なくすることができ、効率のよい画像補正を行うことができる。

【００４６】また、画像処理部４４Ｂおよび画像処理部４６Ｂは、覆い焼き処理やシャープネス処理を必要に応じて行うことができる。画像処理部４４Ｂおよび画像処理部４６Ｂで画像補正された画像データは、データ変換部４４Ｃおよびデータ変換部４６Ｃに送られる。データ変換部４４Ｃは、画像処理部４４Ｂによって処理された画像データを、３Ｄ（三次元）－ＬＵＴ等を用いて変換して、モニタ２０による表示に対応する画像データにする。他方、データ変換部４６Ｃは、同様に、画像処理部４６Ｂによって処理された画像データを３Ｄ－ＬＵＴを用いて変換し、プリンタ１６による画像記録に対応する画像データとしてプリンタ１６に供給する部分である。

【００４７】レンズ特性データ部４７は、各種のカメラの機種に応じたレンズ特性の情報、具体的には、各種のレンズの収差の補正や周辺光量低下の補正や画像ピントボケの補正に用いる補正式の係数を記憶する。また、予め補正量が求められ作成された補正データを記憶保持してもよい。この場合、レンズの歪曲収差や倍率色収差特性や周辺光量分布特性や画像ピントボケの特性が画像領域全体から見て、画像中心線に対する対称性や画像中心点に対する対称性を有するので、これらの対称性を利用して、画像領域の一部の補正データ、たとえば図４（ａ）に示されるように画像全体領域A_4 B_4 C_4 D_4 の４分の１の領域A_4 E_4 O_4 F_4 の補正データしか記憶保持されていない。その結果、補正データを保持するための記憶容量が、画像全体の領域の補正データを保持するために必要な記憶容量よりもはるかに少なく、補正記憶容量を抑え、補正データの呼出しにかかる呼出し時間も短く、画像処理の処理時間の短縮を可能とする。

【００４８】本実施例では、レンズ特性データ部４７の記憶部に補正式や補正データが記憶されているが、これに制限されず、例えば、フォトプリンタ１０に接続されるデータベースに記憶しておき、此所にアクセスして読み出してもよく、あるいは、フィルムＦの読み取り時にフィルムに対応するレンズの情報として外部から入力されてもよい。

【００４９】条件設定部４８は、施す画像処理を選択すると共に、プレスキャンデータを用いて、プレスキャン画像処理部４４および本スキャン画像処理部４６における画像処理条件を設定し、パラメータを統合する。具体的には、プレスキャンデータから、濃度ヒストグラムの作成や、平均濃度、ＬＡＴＤ（大面積透過濃度）、ハイライト（最低濃度）、シャドー（最高濃度）等の画像特徴量の算出等を行い、加えて、必要に応じて行われる操作系１８を用いたオペレータの指示に応じて、グレイバランス調整、明るさ補正、およびコントラスト補正のテーブル（ＬＵＴ）の作成、彩度補正を行うマトリクス演算の作成等の画像処理条件を決定する。キーボード１８ａによって設定された明るさ、色、コントラスト、シャープネス、彩度調等は、入力された各種の指示等に応じて、画像処理条件の調整量（例えば、ＬＵＴの補正量等）を算出し、パラメータとして統合し、画像処理条件を再設定する。

【００５０】以上、処理装置１４の構成について説明した。以下、処理装置１４の作用を説明する。

【００５１】スキャナ１２で読み取られたＲ，ＧおよびＢの各出力信号は、Ａ／Ｄ（アナログ／デジタル）変換、Ｌｏｇ変換、ＤＣオフセット補正、暗時補正、シェーディング補正等が行われる。ここで、シェーディング補正は、結像レンズユニット３２の絞り値またはズーム倍率に応じて、シェーディングも変化するため、絞り値やズーム倍率に応じてシェーディング補正の補正量を変える。このような補正量は、図３に示すように、画像全

体の領域A_3 B_3 C_3 D_3 の４分の１の領域A_3 E_3 O_3 F_3 を画素毎に補正演算を行い補正量を求め、この補正量を用いて、中心線X_3 の線対称性を利用して、領域O_3 H_3 D_3 F_3 の補正量を求め、また、中心線Y_3 の線対称性を利用して、領域E_3 B_3 G_3 O_3 の補正量を求め、また、中心点O_3 の回りの点対称性を利用して、領域O_3 G_3 C_3 H_3 の補正量を求め、画像全体の領域A_3 B_3 C_3 D_3 の画像補正を行う。また補正量を予め求め作成し、図示されない記憶部に記憶保持した光量に関する補正データを呼び出すことによって補正量を得、これを用いてもよい。なお、シェーディング補正の際、スキャナ１２で光電的に画像を読み取る際のＣＣＤセンサ３４を構成するＣＣＤ素子の感度ムラを考慮して、画素ごとにＣＣＤ素子の感度に応じて画像データの補正を行う。

【００５２】Ａ／Ｄ（アナログ／デジタル）変換、Ｌｏｇ変換、ＤＣオフセット補正、暗時補正、シェーディング補正等が行われた後、プレスキャンデータはプレスキャンメモリ４０に送られる。

【００５３】プレスキャンメモリ４０にプレスキャンデータが送られ記憶されると、条件設定部４８がプレスキャンデータを読み出し、濃度ヒストグラムの作成や画像特徴量の算出等を行い、これを用いて、画像処理条件を設定（ＬＵＴやＭＴＸの作成）する。設定された画像処理条件は、統合化され、プレスキャン画像処理部４４および本スキャン画像処理部４６に送る。

【００５４】また、画像処理装置１４には、キーボード１８ａやマウス１８ｂによって入力された各種の指示や情報、スキャナ１２のキャリアで読み取られたフィルムＦの磁気情報が送られており、撮影したカメラの情報が入力された場合には、この磁気情報が条件設定部４８を介してレンズ特性データ部４７に送られる。レンズ特性データブ４７は、得られた磁気情報からレンズ特性データとして補正式の係数が読み出され、画像処理部４４Ｂに送られる。また、予め補正量が求められ作成された補正データを読み出し、これを画像処理部４４Ｂに送ってもよい。

【００５５】次いで、プレスキャンメモリ４０からプレスキャンデータが読み出され、ＬＵＴ・ＭＴＸ演算部４４Ａで、設定された画像処理条件に応じて、スキャナ１２によって読み取られたプレスキャンデータに色バランス調整、コントラスト補正（階調処理）、明るさ補正、彩度補正等が施され、画像処理部４４Ｂに送られる。

【００５６】画像処理部４４Ｂでは、レンズ特性データ部４７から送られた係数を、補正式、例えば２次や３次の高次多項式の係数として与え、この補正式と補正する画素の位置座標とを用いて、補正量を計算して求め、撮影レンズやスキャナ１２の結像レンズユニット３２に起因する歪曲収差や倍率色収差の補正や画像ピントボケの補正や周辺光量低下の補正が行われる。あるいはレンズ特性データ部４７から各画素位置での補正量を予め求めた補正データが送られた場合、この補正データから得られる補正量を用いて、歪曲収差や倍率色収差の補正や画像ピントボケの補正や周辺光量低下の補正が行われる。たとえば、図４（ａ）に示すように、画像領域の縁に沿って互いに直交するＸ軸およびＹ軸を２軸とする位置座標における歪曲収差および倍率色収差の補正を一例とし、図７に示される歪曲収差および倍率色収差のＸ軸方向の補正の方法について説明する。

【００５７】歪曲収差および倍率色収差のＸ軸方向の補正は、ある所定の位置、例えば、画像の角部点B_4 の位置を基準とする画像領域の中心点の位置座標x_c およびy_cを入力し、これと画像補正を行うＧ画素の位置座標x_i およびy_i とから歪曲収差の補正を行う画像領域の画素の中心点からの位置座標を求める。一方、レンズ特性データ部４７で得られた係数を用いて、高次多項式によって表された歪曲収差の補正式D_{out} （ｘ，ｙ）を得、先に求めた中心点からの位置座標とこの補正式D_{out} （ｘ，ｙ）とから補正量を演算して求め、この補正量を位置座標x_i に加算することにより、Ｘ軸方向の歪曲収差の補正を行い、補正後のＸ軸方向の画素位置を得る。

【００５８】Ｇ画素は、以降において行われる倍率色収差の補正において、Ｒ画素およびＢ画素の画素位置のずれ量を求める基準となり、倍率色収差の補正は施されない。したがって、Ｇ画素は、歪曲収差の補正によって補正された画素位置が、曲収差の補正および倍率色収差の補正による補正後のＧ画素の画素位置となる。一方、Ｒ画素およびＢ画素の倍率色収差の補正は、レンズ特性データ部４７で得られた係数を用いて高次多項式によって表された倍率色収差の補正式R_{out} （ｘ，ｙ）およびB_{out} （ｘ，ｙ）を得、これらの補正式と歪曲収差の補正の施された補正後のＧ画素の位置座標とを用いて、Ｒ画素およびＢ画素の倍率色収差の補正量を求め、これに補正後のＧ画素のＸ軸方向の位置座標を加算することで、歪曲収差および倍率色収差の補正の施されたＲ画素およびＧ画素の補正後のＸ方向の位置座標を得る。その際、歪曲収差および倍率色収差については、図４（ａ）や図５（ａ）に示すように、中心点O_4 や中心点O_5 の回りに点対称であり、さらに中心線X_4 や中心線X_5 および中心線Y_4 や中心線Y_5 の回りに線対称であるため、画像領域全体の４分の１にあたる領域、例えば領域A_4 E_4 O_4 F_4や領域A_5 E_5 O_5 F_5 内の各画素位置の補正演算を行い補正量を得、上記対称性を利用して、ほかの領域での補正量を定め、この補正量から補正後の画素位置を得、歪曲収差の補正および倍率色収差の補正を行う。また、レンズ特性データ部４７が、各画素位置での補正量を予め求めた補正データを記憶保持している場合、この補正演算をおこなって補正量を求める替わりに補正データを用いて補正量を得、上記方法と同様の補正

処理を行う。

【００５９】このようにレンズに起因する画質の劣化を抑制する画像補正では、画像領域での画質の劣化の対称性を利用して、補正演算の回数を少なくし、また、予め作成した補正データ量を、画像全体の補正データを保持するために必要な記憶容量よりも少なくすることができる。上記例では、画像領域全体の４分の１にあたる領域の補正演算しか行わない場合、演算時間は４分の１に短縮され、また、補正データを利用する場合も、記憶保持する補正データ量も全画像領域の場合に比べて４分の１になり、効率のよい画像補正を行うことができる。以上が、歪曲収差および倍率色収差のＸ軸方向の補正であり、Ｙ軸方向の補正も同様に、Ｘ軸方向の補正とは別に行われる。

【００６０】その後電子片倍処理を施すために、中心点の位置座標x_cや位置座標y_cを入力し、Ｒ画素、Ｇ画素およびＢ画素のＸ軸方向の位置座標x_{iR}'、x_{iG}'，およびx_{iB}'を得、これを用いて電子片倍処理が施され、画像補正さらには電子変倍処理された画像データを得る。その後、必要に応じて覆い焼き処理やシャープネス処理が施される。

【００６１】画像処理部４４Ｂにおいて補正処理された画像データは、データ変換部４４Ｃに送られ、３Ｄ（三次元）－ＬＵＴ等を用いてモニタ２０による表示に対応する画像データに変換される。その後、補正されたプレスキャン画像がモニタ２０に表示される。

【００６２】オペレータは、モニタ２０の表示を見て、画像すなわち処理結果の確認（検定）を行い、必要に応じて、キーボード１８ａに設定された前記各キー等を用いて色／濃度、階調等を調整する。この調整の入力は、条件設定部４８に送られ、調整入力に応じた画像処理条件の補正量を算出し、この補正量に応じて、前述のように、ＬＵＴ・ＭＴＸ演算部４４Ａや画像処理部４４Ｂにおいて補正処理が施され、モニタ２０に再度表示される。

【００６３】オペレータは、モニタ２０に表示される画像が適正である判定（検定ＯＫ）すると、キーボード１８ａ等を用いて本スキャンの開始を指示する。これにより、画像処理条件が確定し、スキャナ１２から高解像度の本スキャンデータが送られ、プレスキャン画像データと同様に、データ処理部３８で、Ａ／Ｄ（アナログ／デジタル）変換、Ｌｏｇ変換、ＤＣオフセット補正、暗時補正、シェーディング補正等が行われた後、本スキャンデータは本スキャンメモリ４２に送られる。

【００６４】その後、本スキャンメモリ４２から読み出された本スキャン画像データは、本スキャン画像処理部４６に送られ、プレスキャンデータと同様に、ＬＵＴ・ＭＴＸ演算部４８で、確定した画像処理条件によって色バランス調整、コントラスト補正（階調処理）、明るさ補正、彩度補正等が施され、画像処理部４６Ｂに送られる。画像処理部４６Ｂでは、プレスキャンデータに対して画像処理部４４Ｂで行われた補正と同様の方法で、確定した画像処理条件の下に、撮影レンズやスキャナ１２の結像レンズユニット３２に起因する歪曲収差の補正、倍率色収差の補正、周辺光量低下の補正あるいは画像ピントボケの補正を行う。補正が施された本スキャンデータは、データ変換部４６Ｃに送られ、３Ｄ（三次元）－ＬＵＴ等を用いてプリンタ１６にプリント出力する画像データに変換され、プリンタ１６に送られる。

【００６５】プリンタ１６は、感光材料（印画紙）を本スキャンデータに応じて露光して潜像を記録し、感光材料に応じた現像処理を施して（仕上り）プリントとして出力するものである。例えば、感光材料をプリントに応じた所定長に切断した後に、バックプリントの記録、感光材料（印画紙）の分光感度特性に応じた、赤（Ｒ）露光、緑（Ｇ）露光および青（Ｂ）露光Ｇの３種の光ビームを画像データ（記録画像）に応じて変調すると共に、主走査方向に偏向し、主走査方向と直交する副走査方向に感光材料を搬送することによる潜像の記録等を行い、潜像を記録した感光材料に、発色現像、漂白定着、水洗等の所定の湿式現像処理を行い、乾燥してプリントとした後に、仕分けして集積する。このようにして、スキャナ１２の光学系３３の特性やスキャナ１２の光学系３３を構成する結像レンズユニット３２のレンズ特性や画像を撮影したカメラの撮影レンズの特性に応じて、画像補正を行った画像がプリントとして得ることができる。

【００６６】以上、本発明の画像処理装置について詳細に説明したが、本発明は上記実施例に限定はされず、本発明の要旨を逸脱しない範囲において、各種の改良および変更を行ってもよいのはもちろんである。なお、本発明においては、プレスキャン画像処理部４４の画像処理部４４Ｂおよび本スキャン画像処理部４６の画像処理部４６Ｂにおいて歪曲収差の補正、倍率色収差の補正、周辺光量低下の補正や画像ピントボケの補正を行っているが、プレスキャン画像処理部４４の画像処理部４４Ｂでの歪曲収差の補正、倍率色収差の補正、周辺光量低下の補正や画像ピントボケの補正を行わず、本スキャン画像処理部４６の画像処理部４６Ｂのみにおいて上記補正処理を行ってもよい。また、本実施例では、エリアＣＣＤセンサを用いて画像を光電的に読み取るスキャナであったが、フィルムＦをキャリアで走査搬送しつつ画像を読み取るスリット走査によって画像読み取るものであってもよく、この場合においても、画質の劣化は、走査搬送方向に向く画像領域の中心線回りの対称性を有するので、この対称性を用いて、画像補正を効率よく行うことができる。

【００６７】

【発明の効果】以上、詳細に説明したように、本発明によれば、画像読取装置等の光学系に起因する画質の劣化や撮影レンズや結像レンズに起因する画質の劣化を抑制

する画像補正を行う際、画像領域の中心点または中心線に関する画像の劣化具合の対象性を考慮して、画像の一部分の補正量から画像全体の補正を行うので、画像補正処理時間を低減し、また画像補正データ量を低減して、効率よく画像補正を施すことができる。

【図面の簡単な説明】

【図１】　本発明の画像処理装置を利用するデジタルフォトプリンタの一例のブロック図である。

【図２】　図１に示されるデジタルフォトプリンタの画像処理装置の一例のブロック図である。

【図３】　本発明の画像処理装置で行われる画像補正の一例を示す説明図である。

【図４】　（ａ），（ｂ）および（ｃ）は、本発明の画像処理装置で行われる画像補正の他の一例を示す説明図である。

【図５】　（ａ），（ｂ）および（ｃ）は、本発明の画像処理装置で行われる画像補正の他の一例を示す説明図である。

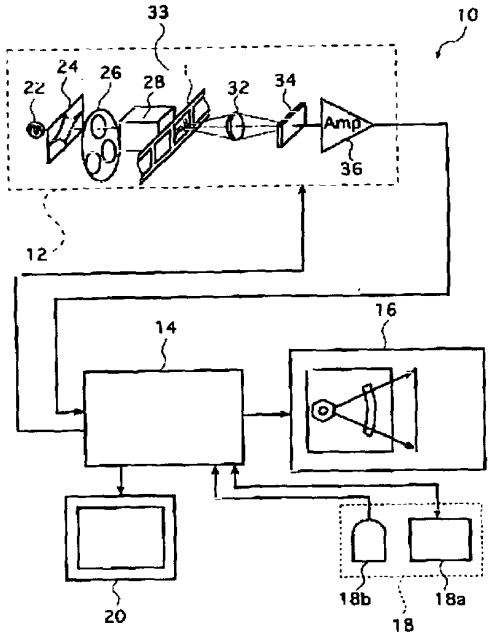
【図６】　（ａ），（ｂ）および（ｃ）は、本発明の画像処理装置で行われる画像補正の他の一例を示す説明図である。

【図７】　本発明の画像処理装置で行われる画像補正の一例の流れを示す説明図である。

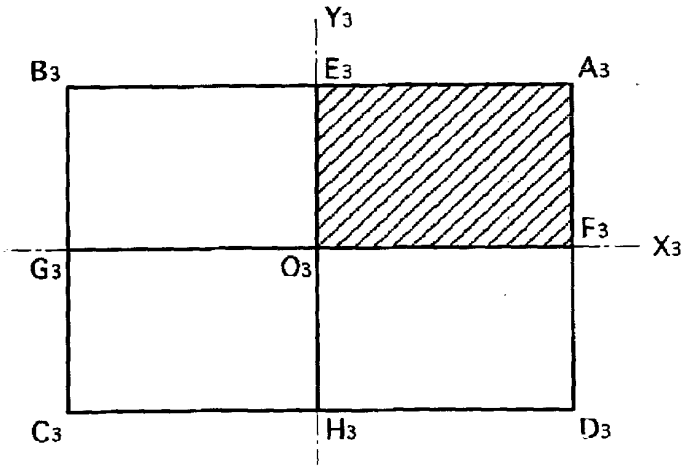
【符号の説明】

１０　フォトプリンタ
１２　スキャナ
１４　画像処理装置
１６　プリンタ
１８　操作系
１８ａ　キーボード
１８ｂ　マウス
２０　モニタ
２２　光源
２４　可変絞り
２６　色フィルタ板
２８　拡散ボックス
３２　結像レンズユニット
３３　光学系
３４　ＣＣＤセンサ
３６　アンプ
３８　データ処理部
４０　プレスキャンメモリ
４２　本スキャンメモリ
４４　プレスキャン画像処理部
４６　本スキャン画像処理部
４７　レンズ特性データ部
４８　条件設定部

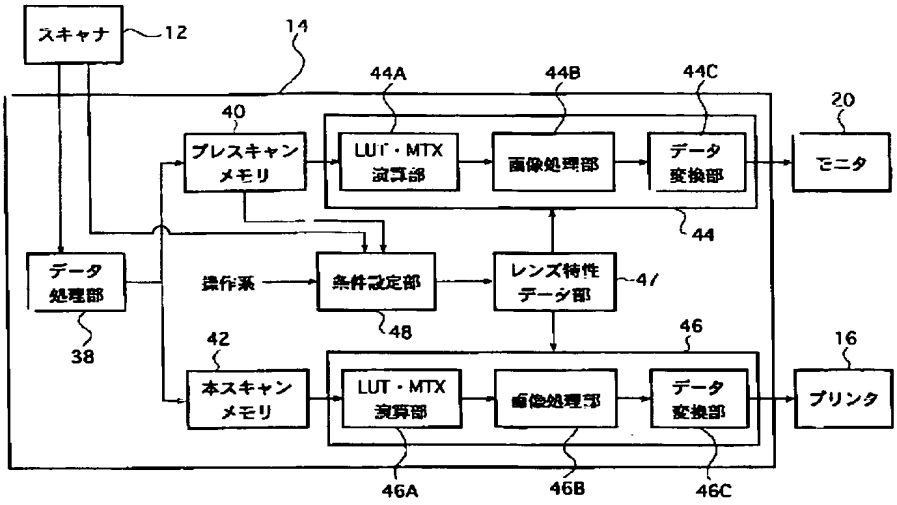
【図１】



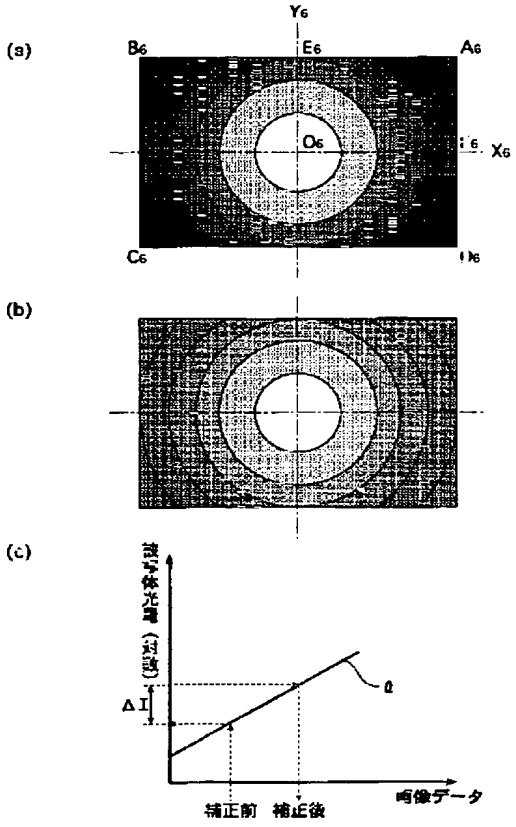
【図３】



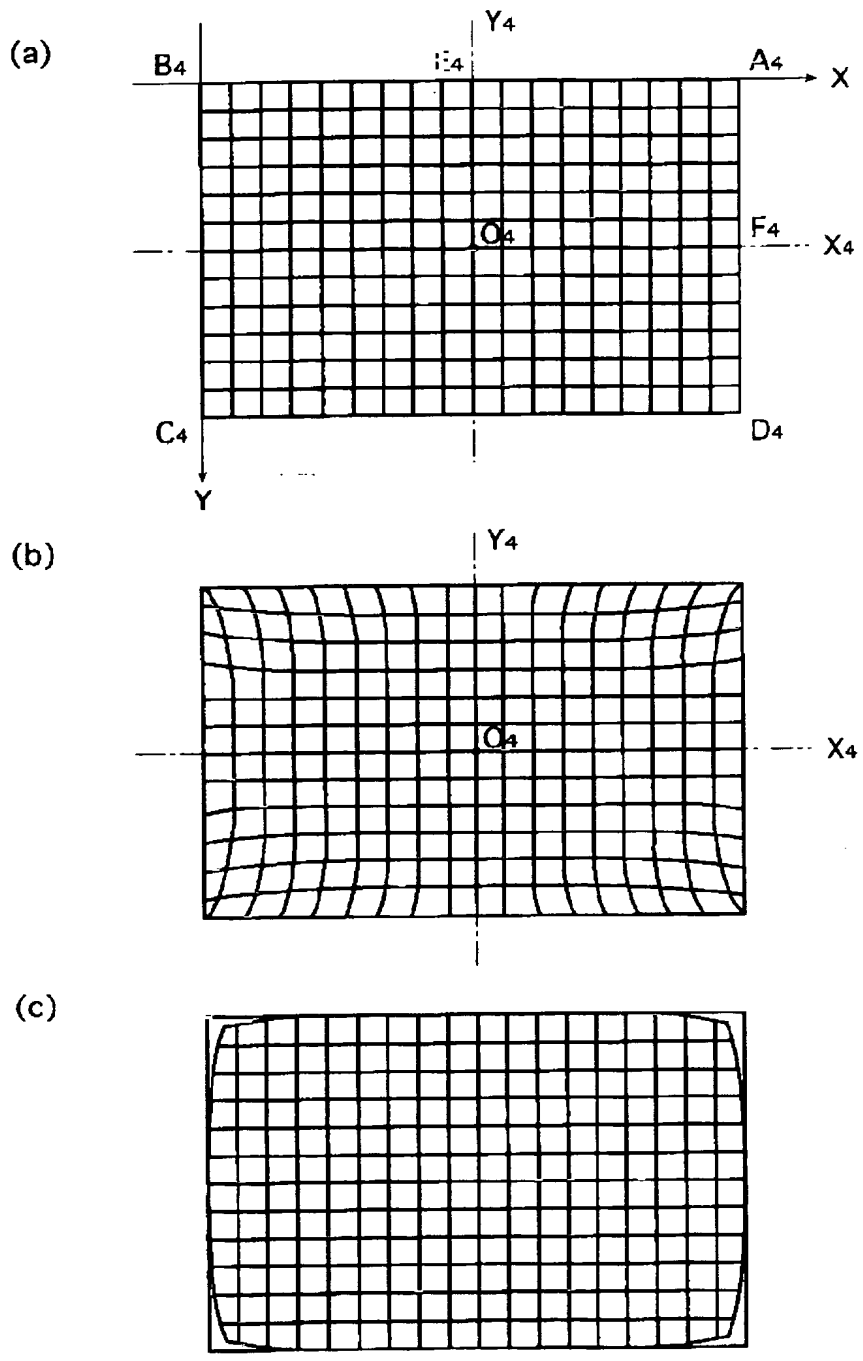
【図2】



【図6】

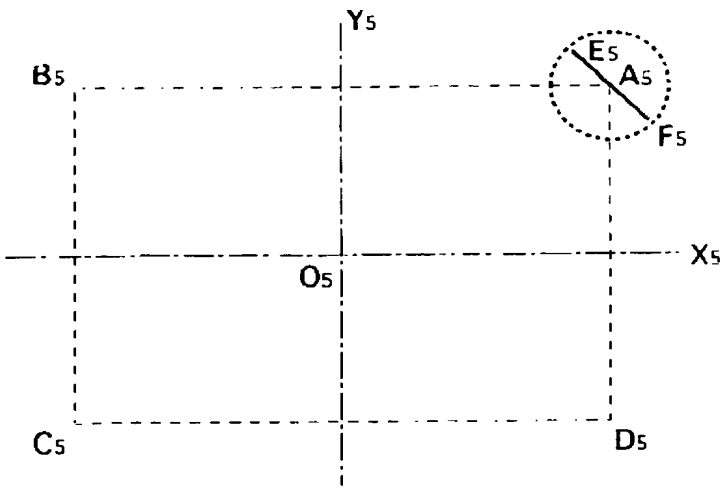


【図4】

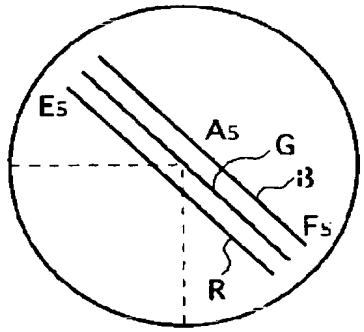


【図5】

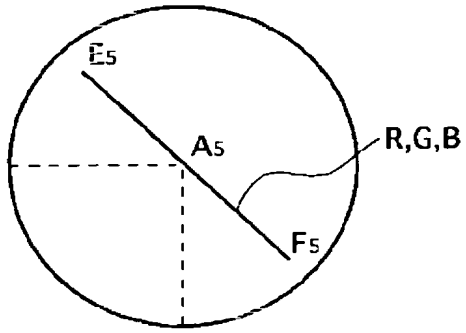
(a)



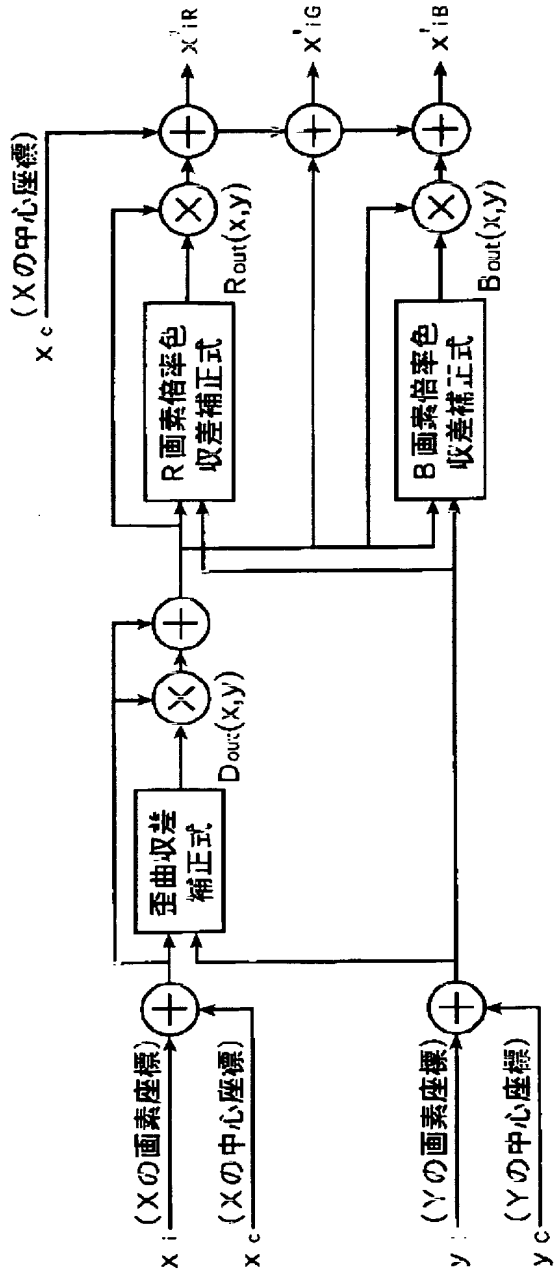
(b)



(c)



【図7】



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DA02 DA23 FB12 NA02 QA17
RA12 UA02 UA06 UA11 VA03
WA04
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